

SECTION 2

EROSION CONTROL PLANNING AND SITE MANAGEMENT

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SITE PLANNING, PREPARATION, AND MANAGEMENT

Natural Resource & Watershed Planning

The most effective solutions to erosion and sediment problems begin with natural resource and watershed planning. This type of planning can guide and control development growth, preventing wasteful and haphazard development. The natural resource planning process integrates ecological (natural resource), economic, and social considerations to meet private and public needs. This approach, which emphasizes identifying desired future conditions, improves natural resource management, minimizes conflict, and addresses problems and opportunities.

Watershed planning is another useful tool for building a community's land use plans because watersheds are defined by natural hydrology, representing the most logical basis for managing water resources. The resource becomes the focal point, and planners are able to gain a more complete understanding of overall conditions in an area and the stressors which affect those conditions.

Regional, county and local planning agencies, Soil and Water Conservation Districts (SWCD), and the Natural Resource Conservation Service (NRCS) have technical expertise, resource data and information that can assist decision making by local authorities. These decisions should consider reserving quality agricultural areas for cropland; maintaining the economic viability of agriculture; protecting historical, scenic, and natural beauty areas; protecting wetlands and stream corridors; providing for open spaces and parks; developing attractive residential, institutional and industrial areas; and maintaining floodplains for flood storage, groundwater recharge, water supply source protection, critical habitat preservation by connecting wildlife populations in fractured landscapes, recreation buffer zones, and conservation education uses. Environmental quality is enhanced when open spaces, parks, recreational areas, ponds, wildlife habitat and other areas of public use become integral parts of the plan. These areas should be well delineated and protected from damage that may occur from nearby construction. Selections of such areas should be based upon soils, vegetation, water, topography, accessibility, wildlife, and aesthetic values.

Environmental Site Design (ESD) Plan

As land is subdivided or proposals brought forward for land development, an assessment of suitability of the site for the proposed development needs to be made. ESD is using small scale stormwater management practices, non-structural techniques, and site planning to mimic natural hydrologic runoff characteristics and minimize the impact of land development on water resources. ESD emphasizes conserving natural features, drainage patterns, and vegetation; minimizing impervious surfaces; slowing down

runoff; and increasing infiltration. Erosion and sediment control needs to be considered from the beginning planning stages and the design and review of erosion and sediment control and stormwater management plans. This includes elements for the preservation of natural features and green infrastructure techniques for the reduction of impervious cover which must be integrated into the site plan approval process (refer to NYS Stormwater Management Design Manual, Chapters 3 and 5).

Natural resources need to be identified in the planning process in order to design an appropriate ESC plan. The plan should have resource protection at its core and emphasize **EROSION CONTROL** (controlling runoff and stabilizing soil), first as its main component and sediment control, second as a management practice. The reduction of soil loss decreases the cost and maintenance of sediment control practices, reduces the risk of degrading natural resources and improves the overall appearance of the construction site.

Erosion and Sediment Control Plan Components

I. Technical Data Requirements

Features of the site including location, site boundaries, accessibility, present land use, delineation of areas protected by local, state and federal regulations (e.g. wetlands and streams), size of proposed tract(s), topography, drainage pattern, geology, hydrology, soils, vegetation and climate need to be assembled. Such information is obtained from on-site examinations and existing technical reports, maps, records, and other documented material usually available from local sources.

This technical data provides the framework necessary to make informed decisions about a site's ultimate use and the types of erosion and sediment controls that will work. Soils information such as detailed soil maps and interpretations are available on the USDA NRCS website, <http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm> and will specifically provide the following soils information:

- a. Descriptions, erodibility, limitations, capabilities, and hydrologic soil groups;
- b. Engineering properties of soils;
- c. Suitability of the soil as a resource material for topsoil, gravel, highway sand, dams and levees;
- d. Site suitability for buildings, roads, winter soil disturbance, foundations, septic tank disposal fields, sanitary land fills, vegetation, reservoirs, dams,

artificial drainage, recreational areas and wildlife development.

II. General Design Process

1. Plan the Development to Fit the Site

Assess the physical characteristics of the site during a site visit to determine how it can be developed with the lowest risk of environmental impact. Minimize grading by utilizing the existing topography wherever possible. Delineate and avoid disturbing wetlands, stream corridors and, to the extent practicable, wood lots, steep slopes and other environmentally sensitive areas.

Minimize impacts by maintaining vegetative buffer strips between disturbed area and water resources.

Existing woody or State protected vegetation on a project site should be delineated, retained, and protected as required. Planning of streets and lots should relate to site conditions. Streets laid out at right angles to contours often have excessive grades that increase erosion hazards and sedimentation.

2. Divide the Site into Natural Drainage Areas

Determine how runoff will drain from the site. Natural waterbodies should not be altered or relocated without the proper approvals. Pursuant to Article 15 of the Environmental Conservation Law (ECL), a protected waterbody and the bed and banks thereof should not be altered or relocated without the approval of the Department of Environmental Conservation. Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act also protects water resources and proposed disturbances may require approvals from The US Army Corps of Engineers.

Integrated surface and storm drainage systems are an essential part of any planned development. The plan should clearly specify: location and capacity of diversions and stormwater basins; paved or other types of lined channels, outlets and waterways; drop inlets; open or closed drains; stream channel protection and bank erosion structures.

Consider how erosion and sedimentation can be controlled in each small drainage area before looking at the entire site.

Diversion of offsite surface water run on away from exposed soils provides the most economic and effective erosion control possible since it is more advantageous to control erosion at the source than to design controls to trap suspended sediment. However, attempting to divert large drainage areas can be problematic. Therefore, the channel should be stabilized and conveyed to a stable outlet/receiving stream. The receiving stream should be evaluated to ensure that its flow regime will not be disrupted. Whenever possible the diversion should be temporary to restore the natural drainage patterns.

3. Determine Limits of Clearing and Grading

Decide exactly which areas must be disturbed in order to accommodate the proposed construction. Pay special attention to critical areas (e.g. steep slopes, highly erodible soils, surface water bodies), which must be disturbed. Additional erosion and sediment controls are often necessary to mitigate the potential impacts to critical or sensitive areas. Staged clearing and grading is necessary to keep unprotected areas of disturbance to less than 5 acres at one time.

4. Design The Erosion and Sediment Control (ESC) Plan

An ESC plan shows the site's existing topography, and how and when it will be altered. It also shows the ESC measures that will be used to reduce sediment pollution and how and when they will be constructed and maintained. The coordination of ESC practices with construction activities is explained on the plan by a phasing and construction sequencing schedule. All projects shall have ESC plans prepared for each phase of the work.

In addition to regulatory control, an ESC plan should be prepared for all land development and construction activity when uncontrolled erosion and sedimentation is anticipated. At a minimum, this includes:

- a. sites on slopes that exceed 15%;
- b. sites in areas of severe erosion potential;
- c. sites within 100 ft. and draining to wetland;
- d. sites within 100 ft. and draining to a watercourse; and/or;
- e. sites with a high percentage of colloidal solids

It is essential for the ESC designer to remember that sediment control facilities, even when designed and constructed properly, rarely exceed 80 percent removal rates for sediment. A properly designed ESC plan for a large scale commercial or industrial site will typically involve several phases, possibly more than one ESC stage and utilize many different practices.

ESC practices are categorized as vegetative and/or structural controls. While more details on these practices are contained in other sections of this book of standards, general information on vegetative and structural controls is outlined below:

- A. Vegetative Controls—The best way to protect the soil surface and limit erosion is to preserve the existing vegetative groundcover. Where land disturbance is necessary, temporary seeding or mulching must be used on areas which will be exposed for more than 14 days. Permanent stabilization should be performed as soon as possible

after completion of final grading. ESC plans must contain provisions for permanent stabilization of disturbed areas. Seed type, application rates, soil amendments, seedbed preparation in accordance with standards contained in this book, mulch, and mulch anchoring must be described on the plans. Selection of permanent vegetation will include the following considerations for each plant species:

- 1) establishment requirements;
- 2) adaptability to site conditions;
- 3) aesthetic and natural resource values;
- 4) maintenance requirements.

B. **Structural Controls**—Structural erosion control practices may be necessary when disturbed areas cannot be promptly stabilized with vegetation. Structural practices shall be constructed and maintained in accordance with the standards and specifications in this document. Structural practices may be temporary or permanent. Temporary practices are removed after site stabilization is completed. Permanent practices, such as diversions, are an integral part of the site design and are left in place.

The ESC plans shall include the following elements:

1. Existing and proposed contours shown at two foot intervals or less. Other scales or contour intervals may be favored for special types of land disturbance projects (i.e. plans are often drawn to scales of 1 in. = 200 ft. or 1 in. = 500 ft. with contour intervals of 5 to 20 feet). The following scales are recommended for use on ESC plans because they facilitate the review process for site specific detailed plans: 1 in. = 20 ft., 1 in. = 30 ft., 1 in. = 40 ft., or 1 in. = 50 ft.
2. Details of temporary and permanent structural and vegetative measures that will be used to control erosion and sedimentation for each stage of the project from land clearing to the finished stage. Stabilizing land with plant materials or mulches shall be part of a planned development. Retention of existing natural vegetation in strategic areas is beneficial, desirable, and cost efficient.
3. The location of structural ESC measures with standard symbols to facilitate the understanding and review of plans. Symbols should have a consistent line weight and be easily discernible on the plans.
4. The dimensions, material specifications, installation details, and operation and maintenance

requirements, for all erosion and sediment control practices, including the locations and size of any temporary sediment traps, basins, or structural practice.

5. Notes regarding temporary ESC facilities which will be converted to permanent stormwater management facilities.
6. A schedule to establish the construction sequence of temporary and permanent practices and their timing relative to other construction activities.
7. An inspection and maintenance schedule for soil ESC facilities which describes maintenance activities to be performed.
8. Dewatering practices for subsurface construction activities.

A sample ESC checklist is contained in Appendix E.

III. Construction of ESCs

Effective erosion and sediment control requires good construction site management. Proper management can reduce the need for maintenance of structural controls, regrading of severely eroded areas, and reconstruction of controls that were improperly or poorly constructed or maintained. Good construction site management also results in efficient use of manpower, financial savings and improves the overall site appearance.

Good construction site management includes the following site phasing and construction sequencing measures:

1. Physically mark limits of land disturbance on the site with tape, signs, or orange construction fence, so that workers can see the areas to be protected.
2. Divert runoff from adjacent land away from exposed highly erodible soils and steep slopes on the construction site toward stable vegetated areas.
3. Clear only what is required for immediate construction activity. Large projects should be cleared and graded as construction progresses. Areas exceeding two acres in size should not be disturbed without a sequencing plan that requires practices to be installed and the soil stabilized, as disturbance beyond the two acres continues. Mass clearings and grading of the entire site should be avoided.
4. Re-stabilize disturbed areas as soon as possible after construction is completed. Fourteen days (seven days in certain cases) shall be the maximum exposure period. Waiting until all

disturbed areas are ready for seeding is unacceptable. Maintenance must be performed as necessary to ensure continued stabilization. Except as noted below, all sites shall be seeded and stabilized with erosion control materials, such as straw mulch, jute mesh, or excelsior, including areas where construction has been suspended or sections completed:

a. For active construction areas such as borrow or stockpile areas, roadway improvements and areas within 50 ft. of a building under construction, a down-slope perimeter sediment control system consisting, for example, silt fencing, shall be installed and maintained to contain soil. Exposed disturbed areas adjacent to a conveyance that provides rapid offsite discharge of sediment, such as a cut slope at an entrance, shall be covered with plastic or geotextile to prevent soil loss until it can be stabilized. Stabilized construction access will be maintained to control vehicle tracking material off site.

b. On the cut side of roads, ditches shall be stabilized immediately with rock rip-rap or other non-erodible liners (e.g. Rolled Erosion Control Products (RECP)), or where appropriate, vegetative measures such as sod.

c. Permanent seeding should optimally be undertaken in the spring from March through May, and in late summer and early fall from September to October 15. During the peak summer months and in the fall after October 15, when seeding is found to be impracticable, an appropriate temporary mulch shall be applied. Permanent seeding may be undertaken during the summer if plans provide for adequate watering. Temporary seeding with rye can be utilized through November.

d. All slopes steeper than 3:1 (h:v), or 33.3%, as well as perimeter dikes, sediment basins or traps, and embankments shall, upon completion, be immediately stabilized with sod, seed and anchored straw mulch, or other approved stabilization measures (e.g. RECP). Areas outside of the perimeter sediment control system shall not be disturbed. Maintenance shall be performed as necessary to ensure continued stabilization.

e. Temporary sediment trapping devices shall not be removed until permanent stabilization (i.e. 80% uniform density of permanent vegetation or permanent mulch/stone) is established in all contributory drainage areas. Similarly, stabilization shall be established prior to converting sediment traps/basins into permanent (post- construction) stormwater management

practices.

5. Where temporary work roads or haul roads cross stream channels, adequate waterway openings shall be constructed using spans, culverts, washed rock backfill, or other acceptable, clean methods that will ensure that road construction and their use do not result in turbidity and sediment downstream. **All crossing activities and appurtenances on streams regulated by Article 15 of the Environmental Conservation Law shall be in compliance with a permit issued pursuant to Article 15 of the ECL.**
6. Make sure that the contractor(s) responsible for the implementation of the Stormwater Pollution Prevention Plan (SWPPP), understands the ESC plan and signs the certification statement required by NYSDEC SPDES General Permit for Stormwater Discharges from Construction Activity (GP).

Inspection & Maintenance

The implementation of an erosion and sediment control inspection and maintenance program is critical for the proper operation of the plan and protection of water resources. Without proper vigil and timely repair and support for the installed erosion and sediment control measures, the practices can easily be overwhelmed and lose their functional effectiveness. To ensure the performance of the erosion and sediment control measures, the contractor(s) that has been identified by the owner as being responsible for the implementation of the SWPPP shall inspect the practices within the active work area daily and after every stormwater event that generates runoff. If deficiencies are identified, the contractor shall implement the necessary corrective actions within one business day of the inspection.

Maintenance for all erosion and sediment control practices shall be in accordance with the specific details included in the SWPPP and incorporated on the ESC plan drawings as appropriate.

Construction Activities

There is a wide array of different types of construction activities. These projects can be grouped into separate categories for the purpose of developing an erosion and sediment control strategy. These generalized categories of land development are:

1. Linear Projects
 - a. Highway and Road Construction
 - b. Gas and Oil Pipeline, Water Supply Line, and Sanitary Sewer Line Construction
 - c. Wind Farm and Power Line Construction

- d. Stream Restoration and Streambank Stabilization
 - e. Shoreline Stabilization
 - f. Flood Dike Systems
2. Residential Projects
 - a. Small scale
 - b. Large scale
 3. Commercial/Industrial Development Projects
 - a. Small scale
 - b. Large scale
 4. Institutional Construction Projects
 5. Water Resources Projects
 6. Large Overlot Grading Projects

In developing plans for highway and road construction, the plan designer will encounter design situations ranging from new highway construction, existing road expansion, intersection and drainage improvements and bridge and culvert rehabilitation; to shoulder widening and overlay projects. While these types of projects differ greatly in their scope and complexity, they all share similar challenges to the ESC plan designer.



These construction projects are typically linear in nature, with limited ROW. Given the limited space within the ROW it may be necessary to obtain temporary easements for control practices such as sediment basins. Working around waterways, streams, or drainage channels within a ROW will also require that special attention be given to the construction details and methods of construction being used in and around the waterways.

Any one individual project may fall into more than one generalized category but these are offered to guide the development of an overall successful site erosion and sediment control plan for the project.

Site variables such as topography, depth to ground water, soil types, and rights- of- way (ROW) constraints all affect the methods of construction including choices of equipment to accomplish the work, phasing and sequencing of construction, and the appropriate erosion and sediment control practices to be employed on the project. In addition, site attributes such as very steep slopes, perched groundwater tables, tidal water fluctuations, stream corridor management, and traffic control requirements impose extra challenges in preparing a comprehensive erosion and sediment control plan.

Note: Performing activities within or adjacent to wetlands, streams and waterbodies may require permits from the New York State Department of Environmental Conservation (NYSDEC) pursuant to Article 15 (Protection of Waters), Article 24 (Freshwater Wetlands) and Article 25 (Tidal Wetlands) of the Environmental Conservation Law (ECL). Project owners should contact NYSDEC's Regional Division of Environmental Permits early in the site planning process to discuss the requirements for meeting permit issuance standards. Following the New York State Standards and Specifications for Erosion and Sediment Control may not ensure compliance with the above referenced sections of the ECL.



The following are examples of projects, with important considerations for plan evaluation, which illustrate the generalized land development categories shown above:

1. Linear Projects

- a. Highway and Road Construction

When an existing roadway is under construction, traffic must often times continue around and through the work area. In these situations, the ESC plan designer needs to address lane shifts, interim access roads being constructed, and other efforts taken to minimize the travel time delay when designing ESC practices. The ESC plan will also need to address the issue of highway

safety from sediment leaving the construction area, and employ a dust control strategy. The use of tire wash facilities and street brooms may also become part of the ESC plan. Proper ESC planning will be necessary to ensure that the use of storm drain inlet devices do not pose a flooding hazard or risk to existing travel lanes. Highway work is typically more dynamic than other types of construction with disturbed areas usually not being left inactive for long periods of time. This may require the use of rolled erosion control products (RECP's) or plastic in order to address temporary stabilization requirements. The following ESC measures must be addressed in the ESC plan:

- Sequence the work to minimize disturbance
- Protect existing drainage ways
- Evaluate de-watering needs and methods
- Minimize access locations
- Stabilize the exposed areas as each phase is completed

b. Gas and Oil Pipeline, Water Supply Line, and Sanitary Sewer Line Construction

The construction of underground pipelines for gas and oil conveyance, water supply lines, or sanitary sewer lines, can result in potentially adverse impacts to natural and cultural resources. Through advance planning of the pipeline construction work, working in the appropriate season, application of erosion and sediment control practices and appropriate construction techniques, natural resources will be protected and adverse impacts minimized.



Utility construction is generally performed in narrow ROW on a specified width. There are several unique aspects of utility work that pose challenges to the ESC plan designer and need to be recognized. Large utility projects pose the greatest risk for ESC problems during construction. Gas and oil transmission lines may be located across multiple watersheds, wetlands, streams, and up and down steep slopes. Pipeline construction involving welded steel pipe requires the trench to be

open for multiple processes of pipe staging, welding, testing and placement. Construction methods must be employed to protect these natural resources. Sanitary sewer lines typically rely on gravity or a combination of gravity with lift stations as needed to operate efficiently. As such they are often sited in lower areas near wetlands, flood plains, and along stream corridors. Where streams must be crossed for utility line construction, the designer must plan for waterway construction permits as well as prepare detailed methods for temporary stream diversions, de-watering operations, and stream or wetland crossings as appropriate.



Smaller utility projects often include servicing residential development with water, sewer, telephone, electricity, gas, and cable TV. While the trend is toward using a common trench for several or more of these utilities, the installation of separate utilities can disrupt the overall sequence of construction, especially with street construction and stabilizing adjacent ROW areas. Direct bury techniques may be used to install electric lines, cable or fiber optic cables, which limits land disturbances by not requiring an open trench. In a residential plan, the installation of utilities must be coordinated, and ESC planned for, especially the restoration and stabilization of disturbed areas. The following objectives, where applicable, must be incorporated in the ESC plan:

- Consider the location of wetland stream resources during the design and planning phase of the project to minimize crossings of such resources;
- Limit vegetation clearing in accordance with safe construction practices to minimize adverse environmental and ecological impacts;
- Construction ROW has to be sized properly, with careful consideration of limiting disturbance yet providing sufficient space for safe operation of large equipment. Areas adjacent to river or large wetland crossings need to be large enough so that all

operations have sufficient space to support work tasks. Confining the crossing staging areas into locations of insufficient space is inefficient and may create extensive damage;

- Confine construction activities to the ROW and vehicular use to designated access roads, construction paths, and staging areas;
- Schedule construction for time periods when sensitive resources are least susceptible to damage or disruption;
- Use construction and pipe laying equipment that minimizes damage and disruption of soils during wet periods or in areas with high ground-water tables, and use the smallest sized equipment to complete the work;
- Limit equipment movement in or near sensitive resources. Phase and sequence the work to limit exposure of work areas such as road crossings, stream and river crossings, wetlands, steep slopes, rocky terrain, and agricultural land;
- Minimize topsoil loss and general soil erosion by limiting ROW grading and other soil scarifying activities, and promptly stabilize disturbed soil;
- Minimize traffic disruption on public roads during pipeline construction by providing adequate traffic controls;
- Provide adequate space for construction paths adjacent to trench systems, temporary sites for material storage and construction staging, and designate the disposition of construction waste material;
- Incorporate adequate trench and site de-watering facilities;
- Provide provisions for site clean-up and a soil and area restoration plan on a phase by phase basis as practical; and
- Provide for pipeline ROW maintenance that includes vegetative treatment, maintenance of erosion and sediment control practices, and landowner improvements as detailed in individual easement agreements.

c. Wind Farm and Power Line Construction

The construction of wind farms and power transmission lines has many similarities to the utility construction methods noted previously. Wind turbine construction, and to a lesser extent transmission line construction will require delivery of both large or long components and very heavy equipment. Wind turbine blades delivery requires a wide turning radius, which requires work at road intersections along the delivery route. Due to the length of blades, both horizontal and vertical profiles of access roads have to be considered. Cranes for wind farms typically arrive on three to five large flat bed

trucks. The individual weights of trucks require special permits and road structures must be considered.



Transmission line substations require delivery of large, heavy components that also require special consideration. Of particular concern are the access routes to reach the wind farm pads and power-line towers, the construction at the turbine pad and power-line tower foundations, and the impact on natural resources at these sites. The following items, where applicable, must be included in the ESC plan:

- Design permanent access roads to avoid wetland and stream resources;
- Limit the amount of clearing and grubbing to that needed to provide access, staging and site construction;
- The construction ROW will have to accommodate large cranes and delivery of long components that will require additional clearing to provide space for turning movements;
- Confine construction to the ROW and vehicular use to the designated access road and staging areas;
- Phase and sequence the work for time periods when sensitive resources and land uses are least sensitive to damage;
- Design appropriate ESC practices to control runoff



during and after construction, and sediment loss while soils are disturbed;

- Provide for the handling of construction waste materials, proper site clean-up, and site stabilization plan; and
- Provide for an operations and maintenance, and inspection plan for the project.

d. Stream Restoration and Streambank Stabilization

Stream corridors and streambanks and their respective buffer areas are extremely sensitive areas and must be adequately protected during construction operations. Diligent planning is required to properly phase the work with particular attention paid to accessing the work locations, dewatering the work areas, providing adequate staging area for construction equipment and operation, and handling construction waste such as cleared and grubbed material and excess spoil.

To protect fish spawning, timing restrictions may be imposed for all instream work as well as any adjacent work that may result in suspension of sediment in a stream. In general, instream work should occur during low flow conditions, typically between June and September, to minimize impacts to fisheries and water quality. For additional information on timing restrictions, please contact the regional NYS DEC office for the county in which the project is located. The following measures, where applicable, must be incorporated in the ESC plan:

- Implement an appropriate de-watering scheme
- Utilize existing former channels where available
- Plan and conduct work in phases upstream to downstream
- Utilize pumps to remove standing turbid water to treatment areas such as traps, basins or filters appropriately sized and stabilized to reduce turbidity
- Stabilize each phase as the work moves downstream
- Timing of planting work is critical for successful vegetative stream bank stabilization



e. Shoreline Stabilization

Stabilization projects for eroded or undermined shorelines can range in scope from shallow grading of beach areas to very high steep banks. These sites can extend from small lot type applications to several hundred feet long. A major concern is the protection the water resource and any surrounding resource attributes such as buffers and wetlands. Slope stability should be assured prior to constructing a project on steep or very high slopes. Consideration of overland surface drainage must be incorporated in the site plan.

Additional items that must be included in the ESC plan are:

- Utilize turbidity curtains or appropriate structural barriers in close proximity to the work area
- Phase and conduct the work in lateral sections
- Permanently stabilize one section prior to disturbing the next section.



f. Flood Dike Systems

These linear structures are usually placed in close proximity to a stream or river extending significant distances to protect the interior area from flood waters. The construction, repair, or rehabilitation of these structures requires that the water resources and adjacent areas be protected from sediment from all disturbance activities. Management of the interior drainage water during construction is critical. Clean water should be bypassed or otherwise diverted around or through the work area. Materials handling should also be recognized and specified. This will include spoil, earthfill, topsoil, as well as waste such as cleared and grubbed vegetative material.



Key measures that must be included in the ESC plan are:

- Phase and conduct the work based on the topography and cut and fill needs
- Sequence the operations to minimize disturbed area exposure
- Install perimeter controls to protect adjacent resources
- Delineate stockpile areas, construction staging areas, and access points
- Bypass clean water around or through the construction site with a stable outlet
- Standing turbid water should be captured or pumped to a treatment device such as a trap, basin, or filter.
- Utilize temporary surface stabilization as the work progresses and apply final stabilization as each phase is completed

2. Residential Development Projects

a. Small Scale- This generally involves the development of interior roads only or single lot grading for home construction. Typical ESC plans for single

family home construction are shown in Appendix D.

b. Large Scale- This activity involves large areas of disturbance for developing interior road access to multiple home sites. Mass or bulk grading is usually performed to complete the infrastructure, individual lots, and the stormwater management practices. There are three stages to a large scale residential development:

- Bulk Grading
- Site improvements
- Home Construction



Each stage is unique with respect to erosion and sediment control, and the management of stormwater during construction. Residential projects will often include multiple phases that may take years to complete. Depending on the size of the development, the developer may not construct the infrastructure (i.e. roads, stormwater conveyance system, other utilities, etc.) for all the phases at the same time. For this reason, it is important that the ESC plans include the necessary integration of the different phases of the project.

Bulk Grading Stage: Bulk or mass grading (sometimes referred to as overlot grading) would require a separate ESC component for that stage. As basins and traps are constructed, there is the added consideration for the planner that home lots will eventually become part of the plan, and the siting of these facilities needs to consider their long term use. As earthwork progresses, the road areas will be “roughed” or “boxed” out if the roadway is in cut; or earth brought in if the road area is in fill. The amount of bulk grading will depend on the earthwork balance for the site. If cuts and fills are balanced within a phase, typically, the bulk grading stage will be easier to manage. Once this stage is completed, the major infrastructure stage begins.

Site Improvements Stage: The next stage involves the installation of roads, major utilities such as sewer and water, and drainage systems. The ESC designer will need to realize that the construction of the roadway and drainage system will alter the interception of stormwater runoff and, in many cases, that the sheet flow occurring during the bulk grading is now concentrated. Energy dissipation with check dams, drop structures, and possibly turf reinforcement in swales and ditches is now necessary. Putting the base course of stone on the road as soon as possible will also reduce erosion potential.

As the roadway cuts and fills are completed and drainage established, temporary stabilization may take place on the lot areas and many of the roadway swales and completed drainage channels are ready for permanent stabilization treatment. It is still too early in the construction phase to activate any of the permanent infiltration/filtration facilities or systems that may have been installed. If located underground the storm drain system must be protected to prevent soil from migrating to the infiltration system. The contributing drainage area including lot areas must be stabilized before permanent infiltration/filtration facilities are put on-line. After the infrastructure is installed and before the site contractor leaves the site, the sediment basins and traps, and the rest of the site, should be checked to determine if maintenance is needed. Although the site should be inspected during the entire construction process, it is crucial to ensure that any major work is performed before the site contractor leaves. Often the building lots and homes are constructed by different sub-contractors that may not have the proper equipment



to perform the necessary maintenance.

Home Construction Stage: The final stage involves the home construction. The lot areas of the site that have been previously stabilized will be disturbed during the construction of the homes. Minor utility installation

such as cable, electric, and telephone are generally installed in a common trench along the road right-of-way. This installation will sometimes interfere with previously installed silt fence and other ESC controls. Ideally, the utilities are installed before the home construction begins, and before the road right-of-way area is stabilized. When utility installation requests are high however, the installation priority may be tied to the number of building permits issued in a given development phase. This may necessitate the road right-of-way areas having to be stabilized twice.



3. Commercial and Industrial Development

These development projects share many of the attributes of large scale residential development; that is significant overlot grading and drainage challenges. It is important that the stormwater management systems and treatments be installed for the project site early in the development process to assure proper control. Particular care should be taken to stabilize access locations and control dust during the construction operations.

a. Small Scale- These sites are generally less than 3 acres with a building footprint of 5,000 to 20,000 square feet, such as **convenience stores, gas stations, fast food restaurants, individual retail outlets or industrial park building pad sites**. Typically, perimeter controls such as silt fence may be employed. A stabilized construction access to all point of ingress and egress is important and will need constant attention to maintenance due to frequent traffic from trucks hauling structural building materials. Depending on the permanent stormwater design of the site, a stormwater pond may be utilized as a temporary sediment basin. If not, a temporary sediment trap may be employed with perimeter berms to direct sediment laden runoff to the trap. These berms may be constructed from the topsoil stripped from the site. Used as berms around the perimeter, the topsoil does not take up room as a

stockpile, which is often a problem on a small site. After final grades are established, the topsoil should then be restored to areas of the site that will be permanently vegetated.

Generally, the building foot area or pad site is excavated first, with rough grading taking place around the remainder of the site. While the building area is being constructed, the stormwater system is installed and inlet protection is constructed. If the remainder of the site requires extensive grading later, temporary stabilization will be applied initially. Once stabilized, this site should require simple routine maintenance until the remainder of the site area is final graded for parking and landscaping. If only minor grading on the site is required, the sequence may be such that grading and base course stone could occur early in the construction. This would also reduce the amount of bare soil exposure. One important note; some small commercial sites rely on infiltration, filtration, or bio-retention for their permanent stormwater management. The function of these facilities is often compromised when they are utilized for sediment control, compacted by heavy equipment, or installed prematurely and allowed to become clogged with sediment. The ESC portion of the plan has to be developed to complement the post-development stormwater management strategy.

b. Large Scale- These projects are greater than 3 acres in area, such as **shopping centers, office complexes, industrial parks, transportation facilities, and multi-use development projects**. The designer can introduce phasing into the site planning process even when the site is less than 20 acres to make complex sites more manageable. In discussing phasing it is important to define the clearing, grubbing, and grading stages of construction. Land disturbing activities include land change such as clearing, grading, excavating, transporting and filling of land. On a wooded site, cutting down or clearing trees is a land disturbing activity. There is a way through proper sequencing, to develop a portion or phase of a site

while simultaneously clearing and grading another phase. While phasing is an important tool in managing ESC activities, the plan needs to consider some flexibility among phases. If a sediment basin is to be constructed in Phase 1, it may be necessary to place the excavated material at a central location, possibly in another phase. Phasing also works well if the phases are broken into separate drainage areas.

A well designed ESC plan for commercial/industrial development will reflect that the site will likely be mass or bulk graded. There are typically very few areas of these sites that will remain undisturbed except for areas that are protected. In some cases extreme changes in grading are necessary to ensure a relatively flat building site. In other cases multiple drainage areas will be graded to one control point, or drainage areas may be divided to outlet at different locations.

During the bulk grading of a large site, the phasing is clearly the key to managing ESC activity. However, even within a phase of construction, it may be necessary to develop two ESC plans. The first plan would be developed for the bulk grading activity. Since the stormwater or drainage collection system is not installed at this time, the ESC plan will rely on temporary berms, swales, and diversions to convey sediment laden water to traps and basins. A second plan would be necessary when rough grading nears completion, buildings, roads, and parking areas are under construction, and now drain to the same traps and basins through an improved stormwater conveyance system. The ESC strategies are very different during the bulk grading and infrastructure development stages.

It is essential for the ESC designer to remember that sediment control facilities, even when designed and constructed properly, rarely exceed 80 percent removal rates for sediment. A properly designed ESC plan for a large scale commercial or industrial site will typically involve several phases, possibly more than one ESC stage and utilize many different practices.



4. Institutional Development Projects

These projects include the development of structures, facilities, and infrastructure such as roads, utilities and stormwater drainage systems in institutional settings such as **college campuses, correctional facilities, public and private school construction, and transportation terminals such as bus stations**. Many of the key points previously discussed for ESC plans are applicable here as well. It is especially important to note that often institutional construction projects are undertaken in close proximity to ongoing public activities and the drainage from these projects is often tied into the existing stormwater system. The following measures shall be incorporated in the

ESC plan:

- Establish safe, stabilized, controlled access points for the construction limits
- Develop a materials handling protocol for all potential pollutants and construction waste generated by construction activities
- Control dust from construction operations and vehicular traffic
- Maintain noise levels of the construction operations to acceptable levels for the surrounding environment
- Utilize temporary stabilization and permanently stabilize each phase as soon as its work is completed



5. Water Resources Projects

These projects are unique in that they are generally constructed within or in very close proximity to water resources. These include **dam construction for lakes, ponds, or reservoirs**, whose purposes may be flood protection, energy creation or recreational for fish and wildlife. It also includes **embankments and grading for wetland restoration projects** as well as construction activities for agricultural support such as **agricultural waste storage and management facilities such as lagoons, waste treatment wetlands, barnyard runoff treatment systems and composting facilities**. The ESC plan for these projects should contain many of the points listed previously for general grading activities. In addition, key elements of the construction sequence for earthen dam embankments shall include the following:

- Divert the stream flow in stable manner
- Construct the cutoff trench and service spillway system
- Utilize earthfill from the auxiliary spillway first
- Permanently stabilize the auxiliary spillway
- Re-locate the stream flow through the service spillway system
- Complete the earthfill and permanently stabilize all disturbed areas

6. Large Bulk, Overlot Grading Projects

These projects include construction of golf courses, recreational ski areas and facilities, large municipal projects such as airports and sewage treatment plants, and steep slope stabilization areas. The majority of these projects share many of the same attributes, concerns and ESC plan requirements as large scale residential, commercial, and industrial projects. However, the stabilization of steep slopes is unique and deserves separate evaluation. Many factors will determine the engineering treatment for stabilizing an unstable steep slope. These include, but are not limited to, soil type, gradation, groundwater levels and seepage, slope steepness and length, surface drainage, active erosive forces, and the proposed use of the area within the bigger site complex. Key measures that must be included in the ESC plan and construction sequence are:

- Divert surface runoff at the top of the slope
- Divert water by use of water bars
- Make sure the slope and its toe area are stable
- Utilize slope drains as necessary to control seepage
- Bench the slope as needed for stability, access, and surface drainage
- Plan and conduct the work to minimize exposure
- Stabilize exposed areas as soon as possible as the work progresses

In summary, these six categories of construction activities highlight some of the variables that should be addressed in ESC plans.



Recognize that every construction project is unique. It may involve a totally new land disturbance or re-configuring and re-developing previous work. It could be located in an urban, suburban or rural area and may involve working with existing impervious areas. Regardless of these circumstances, the erosion and sediment control plan must be prepared to deal with all the potential adverse impacts that could occur to on-site and off-site water resources.

The majority of the standards contained in this book are applicable and adaptable to most of the construction activities previously discussed. However, some of the standards will not be applicable for all activities. The Erosion and Sediment Control Practices Matrix, Table 2.1, indicates which construction activities summarized above, where a particular standard practice is most likely suited for implementation.



Design Process for Erosion and Sediment Control Plans

The design of erosion and sediment control needs to be integrated with the stormwater plan for the project. Since every project is different in its topography, soils, geometry, hydrology, groundwater depths, and intended purpose, it is important to consider all of these attributes as well as post construction stormwater management as ESC plans are developed. A firm knowledge of the New York State Stormwater Management Design Manual criteria and requirements is helpful when integrating green infrastructure planning and practices for runoff reduction such as preservation of natural areas and soil restoration as well as the implementation of standard stormwater treatment practices such as infiltration basins and others. The following design steps detail the process and required elements for developing an ESC plan:

Step 1. Identify existing drainage patterns, drainage area boundaries, and slopes

Current drainage information for the project site, as well as off-site, needs to be obtained and verified through a site visit and survey. Field check drainage patterns, drainage area boundaries, vegetation and land use. Look for existing storm drains, culverts, underground utilities, and other drainage features. Evaluate flow onto, through, and off of the site for existing conditions. Examine the drainage areas to determine the size, slope, slope length, flow path, and, for areas with concentrated flow, the discharge. Decide if off-site flow can be diverted through or around the site. Using ESD principles and green infrastructure techniques, maintain or mimic the existing drainage patterns that give preference to sheet flow and small drainage areas.

Step 2. Identify areas of special concern

Areas of particular environmental concern, such as wetlands, streams, buffers, wooded areas, slopes 15 percent or steeper, and highly erodible and unique soils, need to be identified within both the project site and adjacent areas and shown on the plan. Other considerations include phosphorous impaired watershed areas; National Wetland Inventory; natural heritage areas; rare, threatened, and endangered species habitat; and impaired stream segments with a Total Maximum Daily Load for sediment. Areas of special concern must be verified with a site visit. Note any erosion, lack of vegetation, drainage problems, and other features that may be pertinent to the design. If an unmapped resource is found, contact the appropriate authority to determine additional regulatory requirements.

Step 3. Inventory site and layout development

The initial assessment of the layout needs to be based on the

existing features and proposed construction, minimizing the project's impervious area, acreage of soil disturbance and the encroachment on natural resources in accordance with the green infrastructure planning principles described in chapters 3 and 5 of the New York State Stormwater Management Design Manual and the environmental site design techniques noted earlier in this section. A site program plan has to provide space for the project water, sewer, stormwater facilities, parking, recreation areas and green space. A comprehensive approach to developing the erosion and sediment control and stormwater management plans will minimize changes from the natural hydrology. In addition, expansion of forest, wetland, and stream buffers needs to be considered for enhanced sediment control and improved water quality.

Step 4. Determine phasing requirements and design initial erosion and sediment controls

Depending on the scope of the project, phasing of sediment control and grading may be necessary (e.g., initial, interim, and final phase). Initial controls need to consider existing topography, drainage areas, ground cover, and access throughout the site. If possible, sediment controls installed during the initial phase should be designed to function for all phases of the project. The best designs incorporate careful phasing and sequencing into the overall erosion and sediment control plan and construction strategy. This is often evident in the project's contract construction schedule.

In designing erosion and sediment controls, consider possible locations for staging and stockpile areas and access or haul roads. If staging/stockpile areas are within the project's limit of disturbance, the proposed perimeter controls may suffice. However, if a soil stockpile creates a longer slope length or steeper slope, perimeter controls must be adjusted accordingly. Additionally, an access road may be required down a slope thereby concentrating flow that was previously sheet flow. Considerations must be made for handling this concentrated flow and stabilizing and maintaining the access road. The design and installation of erosion and sediment control practices must not impact areas identified for green infrastructure purposes. For example, compacting soils in areas designated for infiltration, or removing trees or other vegetation identified for stormwater management, is not permissible. However, infiltration basin locations may be used as sediment basins/traps where partial excavation is performed to a minimum limit of 18" above the bottom of the infiltration basin.

Table 2.1 identifies the erosion and sediment control practices contained in this book of standards and lists the primary purpose of each practice along with design criteria and associated practices that might be found used in combination with the listed practice. For example, rock outlet protection, sediment trap, and storm drain inlet are listed as associated practices for the earth dike practice.

Each practice application needs to be evaluated on a case-by-case basis for its associated practices due to the changing characteristics of the project.

The sequencing of a site must take into account the time and access needed to install the initial sediment controls. If earth dikes and a sediment basin are designed as initial controls, these must be completed before beginning other grading. This could require stockpiling the excavated material from the basin rather than using it immediately for fill on the site. Sequencing is also important to ensure that the basin is completed and stabilized prior to the construction of the berms. Additional sediment controls may be required if extensive clearing is needed to reach the proposed basin location.

Step 5. Identify interim drainage patterns, drainage areas, slopes; and design interim controls

Interim conditions are often overlooked yet are important considerations for erosion and sediment control design. Typically, evaluating interim conditions is more difficult than evaluating initial phase or final phase. Project plans always include existing and proposed site conditions. Unlike the initial or final phases, interim conditions are not definitive; they represent the in-between. Due to the shifts in drainage areas and changes in slope and exposure of sub-surface soils, drainage patterns and discharges for an interim phase may be entirely different from initial or final phase, and therefore the erosion and sediment controls may also need to be different. To design interim controls, apply the same procedures used to design initial phase sediment controls. Initial and final phase controls may need to be adjusted or modified to better correlate with the interim phase controls. Depending on the scope of the project, an interim phase erosion and sediment control plan may not be required.

Step 6. Identify proposed drainage patterns, drainage areas, slopes; and design final controls

Follow the same procedures used to design the initial phase erosion and sediment controls. Initial and interim phase controls may need to be adjusted or modified to better correlate with the final phase plans. As construction progresses, consider impacts to staging and stockpile areas and access roads. Also, consideration needs to be given to how the controls implemented for the final phase will be removed.

Step 7. Prepare the Construction Sequence

The sequence of construction describes how the plan will progress. It directs the installation and removal of the different erosion and sediment controls shown on the plan. Sequencing of the project needs to be considered throughout the entire design process. When writing a

sequence of construction, consider whether additional instructions will be helpful to ensure that the controls function as intended. Different types of construction activities will require different sequences for construction. If the disturbed area in any one particular phase of the construction work exceeds 5 acres at any one time, additional control efforts will be required and written acceptance of this plan from the Regional NYSDEC office or MS4 (for projects subject to a traditional land use control MS4) must be received and incorporated in the project documents.

Writing a sequence of construction requires the visualizing and the progression and connection of various site development activities (e.g. clearing, grubbing, grading, utility installation, maintenance of traffic, drainage systems, building systems, stream diversions, erosion and sediment control, stormwater management, etc.) to ensure that the erosion and sediment control practices will be installed and removed at the proper times, and function properly. Depending on the project's complexity, the sequence can be relatively simple or it can involve many small steps. Multiple steps can occur concurrently, while others must be sequential. Large projects that have been segmented into phases should have a separate sequence for each phase. Large projects often follow a prescribed critical path for the construction work. These paths are helpful in developing narratives to explain to contractors and inspectors why a certain erosion and sediment control practice was selected or why following the sequence is imperative to the proper progression of the construction and erosion control effectiveness.

The sequence of construction, at a minimum, must include the following:

- Schedule a pre-construction meeting with appropriate permitting authority
- Delineate resources to protect
- Establish staging area, construction entrance, topsoil stockpile, and concrete truck washout areas
- Protect post-construction practice areas during construction to preserve native soil permeability, install SMP's only after site is stabilized
- Clearing and grubbing as necessary for the installation of perimeter controls
- Establish method of spoils disposal (on-site or off)
- Construction and stabilization of perimeter controls
- Install initial runoff controls and stabilization
- Remaining clearing and grubbing within perimeter
- Road grading
- Grading for the remainder of the site or phase
- Utility installation and connections
- Construction of buildings, roads, and other construction
- Installation of permanent stormwater management measures
- Conduct soil restoration

- Final fine grading, landscaping and stabilization
- Removal of temporary erosion and sediment controls
- Restore and stabilize any disturbed areas remaining upon removal of temporary ESC measures

Most sequences of construction will be more detailed, especially for plans requiring stream diversion, ground water management, or the coordination between the removal of controls in one phase and the installation of different controls in a subsequent phase. If traffic control is a factor, then the erosion and sediment control plan should coordinate with the maintenance of the traffic plan. For subdivision projects, the sequence of construction must identify lots having sediment control practices that preclude the lot from being developed until the contributing drainage area has been final graded and stabilized. Each project is unique and the level of detail in the sequence of construction needs to be tailored to each specific project.

The Erosion and Sediment Control Practices Matrix was prepared as a quick reference for designers and reviewers to obtain major pertinent information about a practice. The matrix is alphabetical and is sectioned by each major control group in this book of standards. Each practice has listed its primary use on the site, the important site characteristics and criteria for application, the type of construction activity where it is best applied, and other associated practices that are often used with it to complement its performance.

The Construction Activity Key, shown below, assigns a number or number and letter to indicate a specific construction activity. Those symbols are listed in the Construction Activity column of the matrix to indicate the applicability of a practice to a particular type of construction. This information is presented as a guide for use and is not to be considered as limiting any particular practice to the activity listed.

Erosion and Sediment Control Practice Matrix Construction Activity Key

1. Linear Projects
 - a. Highway and Road Construction
 - b. Gas and Oil Pipeline, Water Supply Line, and Sanitary Sewer Line Construction
 - c. Wind Farm and Power Line Construction
 - d. Stream Restoration and Streambank Stabilization
 - e. Shoreline Stabilization
 - f. Flood Dike Systems
2. Residential Projects
 - a. Small scale
 - b. Large scale
3. Commercial/Industrial Development Projects
 - a. Small scale
 - b. Large scale
4. Institutional Construction Projects
5. Water Resource Projects
6. Large Overlot Grading Projects

Table 2.1
Erosion and Sediment Control Practices Matrix
Site Planning, Preparation and Management

Practice	Primary Purpose	Site Characteristics	Construction Activity*	Associated Practices
Concrete Truck Washout	Collect Waste	Concrete construction	All	Stabilized Access
Construction Road Stabilization	Control sediment	All construction routes	All	Dust control, temporary swales, temporary or permanent seeding
Dust Control	Stabilize soil	Access points, construction roads	1a,1b,2,3,4,6	Stabilized construction access, construction road stabilization
Protecting Vegetation During Construction	Preserve existing vegetation	Site specific	All	Recreational area improvement
Site Pollution Prevention	Manage waste	Site logistics	All	Those in this section
Stabilized Construction Access	Control sediment	Access points	All	Filter fence, construction road stabilization
Temporary Access Waterway Crossing	Prevent sediment	Streams and banks	All	Construction road stabilization, streambank protection
Winter Stabilization	Soil stabilization	Disturbed areas	All	Seeding, mulching, buffer strips
* See Erosion and Sediment Control Practice Matrix Construction Activity Key on page 2.15				

Table 2.2
Erosion and Sediment Control Practices Matrix
Erosion Control Part 1 - Runoff Control (See Section 3)

<u>Practice</u>	<u>Primary Purpose</u>	<u>Site Characteristics</u>	<u>Construction Activity</u>	<u>Associated Practices</u>
Check Dam	Control runoff	Drainage area ≤ 2 Ac.	All	Lined waterway, rock outlet protection
Construction Ditch	Divert runoff	Drainage area ≤ 10 Ac.	All	Sediment traps, storm drain inlet protection, sediment basin, level spreader
Dewatering Sump Pit	Control sediment	Site specific	All	Sediment trap, sediment basin
Diversion	Intercept and divert runoff	Minimum 10 year design Q	1a,2b,3b,4,5,6	Permanent seeding, rock outlet protection, flow spreader, sediment basin
Earth Dike	Control runoff	Drainage area ≤ 10 ac.	1a,1b,1c,2,3,4,5,6,	Sediment trap, rock outlet protection, sediment basin
Flow Diffuser	Control runoff	Minimum design Q = 10 yr. 24 hr.	1a,1b,1c,5,6	Seeding, sodding, land grading, diversion
Flow Spreader	Control runoff	Minimum design Q = 10 yr. 24 hr.	1a,1b,1c,5,6	Diversion, grassed waterway, construction ditch
Grade Stabilization Structure	Prevent erosion	Minimum design Q = 10 yr. 24 hr.	1d,1e,5,6	Permanent seeding, rock slope protection, structural stream-bank protection
Grassed Waterway	Convey runoff	Minimum 10 year design Q	2a,3b,5,6	Rock outlet protection, vegetated waterways, sediment basin, flow spreader
Lined Waterway (rock materials)	Convey runoff	Minimum design Q = 10 yr. 24 hr.	1a-c,2,3,4,5,6	Rock outlet protection, subsurface drain
Paved Flume	Convey runoff	Minimum design Q = 10 yr. 24 hr.	1a,3,4,6	Rock outlet protection
Perimeter Dike/Swale	Divert runoff	Drainage area ≤ 5 Ac.	1a-c,2a,3a,5,6	Sediment trap, flow spreader, check dam, temporary seeding
Pipe Slope Drain	Convey runoff down slope	Drainage area ≤ 3.5 Ac.	1a,1d,5,6	Rock outlet protection
Rock Outlet Protection	Prevent erosion	Rock varies with pipe discharge	All	Diversion, grassed waterway, sediment basin, sediment traps
Storm Drain Diversion	Divert runoff	On-site drainage area > 50% total drainage area	1a,2,3,4,6	Sediment trap/basin
Subsurface Drain	Intercept and convey drainage water	1" Drainage Coefficient	1a,2,3,4,6	Rock outlet protection, land grading, retaining wall
Water Bars	Divert runoff	Slope areas < 100 ft. width	1b,1c,5	Rock outlet protection, flow spreader

* See Erosion and Sediment Control Practice Matrix Construction Activity Key on page 2.15

Table 2.3
Erosion and Sediment Control Practices Matrix
Erosion Control Part 2 - Soil Stabilization (See Section 4)

<u>Practice</u>	<u>Primary Purpose</u>	<u>Site Characteristics</u>	<u>Construction Activity</u>	<u>Associated Practices</u>
Anchored Stabilization Matting	Stabilize soil	Site specific	All, steep slopes	Seeding, topsoiling
Armored Slope and Channel Stabilization	Prevent erosion	Minimum design Q= 10 yr. 24 hr., velocity > 6 feet per second	1d,1e,1f	Live facines, live stakes, retaining walls
Branch Packing	Stabilize soil	Maximum 1.5:1 slopes	1d,5,6	Diversion, subsurface drain, temporary swale
Brush Layer	Stabilize soil	Site specific slopes	1d,1e,3,4,5,6	Rock slope protection, armored streambank protection
Brush Mattress	Stabilize soil	Stream bank slopes	1a, 6	Rock slope protection
Establishing Trees, Shrubs, and Vines	Stabilize soil	Site specific	All	Topsoiling, seeding, fertilizer application
Fertilizer Application	Promote seeding	Site specific	All	Seeding, mulching, topsoiling, land grading
Fiber Roll	Provide growth medium	Site specific	1d,1e,5	Live facines, live stakes
Land Grading	Stabilize soil	Site specific shaping	All	Topsoiling, subsurface drain, seeding
Lime Application	Stabilize soil	Site specific	All	Topsoiling, seeding
Live Crib Wall	Stabilize soil	Site specific	All	Retaining walls
Live Fascines	Stabilize soil	Max. 1.5:1 slope	1a,1d,1e,5,6	Diversion, seeding
Live Stakes	Stabilize soil	Site specific	1d,1e,4,5,6	Armored streambank protection, fiber roll
Loose Stabilization Blankets	Stabilize soil	Site Specific	All	Permanent and temporary seeding, Recreation area
Mulching	Stabilize soil	Site specific	All	Permanent and temporary seeding, Recreation area
Permanent Seeding for Construction Areas	Stabilize soil	Site specific	All	Surface roughening, top soiling, sodding
Recreation Area Seeding	Protect areas/soils	Site specific	All	Permanent seeding, mulching, topsoiling
Retaining Walls	Stabilize soil	Site specific constraints	1a,2,3,4,6	Rock slope protection, permanent seeding, subsurface drain
* See Erosion and Sediment Control Practice Matrix Construction Activity Key on page 2.15				

Table 2.3 (Continued)
Erosion and Sediment Control Practices Matrix
Erosion Control Part 2 - Soil Stabilization (See Section 4)

<u>Practice</u>	<u>Primary Purpose</u>	<u>Site Characteristics</u>	<u>Construction Activity</u>	<u>Associated Practices</u>
Soil Restoration	Stabilize soil, promote infiltration	Compacted areas	All	Topsoiling, seeding
Stabilization of Sand and Gravel Pits	Stabilize soil	Site specific	1a,1c,3,4,5,6	Topsoiling, seeding
Stabilization With Sod	Stabilize soil	Need quick cover, aesthetics	2,3,4	Inlet protection, top soiling, permanent seeding
Surface Roughening	Stabilize soil	Construction slopes	All	Temporary seeding, permanent seeding, mulching
Temporary Seeding for Construction Areas	Stabilize soil	Site specific	All	Surface roughening, top soiling, sodding
Topsoiling and Amendments	Enhance growing conditions	Poor site soil characteristics	All	Surface roughening, temporary seeding, permanent seeding
Tree Revetment	Stabilize soil	Site specific	1d,1e	Armored streambank protection
Vegetated Gabions	Stabilize soil	Site specific	1a-e,2,3,4,5,6	Live cribwall, retaining wall
Vegetating Sand Dunes and Tidal Banks	Stabilize sand dunes	Sand dune reinforcement	1e, 2,3,4,5,6	Sediment trap, rock outlet, storm drain inlet protection
Vegetating Waterways	Stabilize soil	Site specific	2a,3b,5,6	Grassed waterways, permanent seeding
* See Erosion and Sediment Control Practice Matrix Construction Activity Key on page 2.15				

Table 2.4
Erosion and Sediment Control Practices Matrix
Sediment Control (See Section 5)

<u>Practice</u>	<u>Primary Purpose</u>	<u>Site Characteristics</u>	<u>Construction Activity</u>	<u>Associated Practices</u>
Buffer Filter Strip	Filter sediment	Turbid sheet flow	All	Storm drain inlets, water conveyances
Compost Filter Sock	Filter sediment	Turbid sheet flow	All	Storm drain inlets, water conveyances
Dewatering Device	Discharge clean water	Turbidity in sediment basin	All	Sediment basins, sediment traps
Geotextile Filter Bag	Filter sediment	Small areas, pumped	All	Subsurface drain, dewatering sump pit, buffer filter strip
Portable Sediment Tank	Retain sediment	16 times pump discharge	2a,3a,4	Sediment trap, sediment basin
Rock Dam	Trap sediment	Drainage area \leq 50 Ac.	1a,1b,1c,2b3b,4,5,6	Rock outlet protection
Sediment Basin	Capture sediment	Drainage area \leq 50 Ac.	1a,2b,3b,4,5,6	Rock outlet protection, temporary seeding
Sediment Dike	Capture sediment	Small disturbed areas	2a,2b,3a	Buffer filter strip, filter bag
Sediment Trap - Compost Sock	Trap sediment	Drainage area \leq 5 Ac.	All	Seeding, sodding
Sediment Trap - Pipe Outlet	Trap sediment	Drainage area \leq 5 Ac.	All	Sediment basin, rock outlet protection
Sediment Trap - Stone Outlet	Trap sediment	Drainage area \leq 5 Ac.	All	Rock outlet protection
Silt Fence	Control sediment	2:1 slopes maximum, 50 ft. spacing	All	Straw bale dike
Storm Drain Inlet Protection - Excavated	Trap sediment	Drainage area \leq 1 Ac.	1a,2,3,4,6	Sediment traps, storm drain diversion
Storm Drain Inlet Protection - Fabric	Trap sediment	Drainage area \leq 1 Ac.	1a,2,3,4,6	Sediment traps, storm drain diversion
Storm Drain Inlet Protection - Inserts	Trap sediment	Drainage area \leq 1 Ac.	1a,2,3,4,6	Sediment traps, storm drain diversion
Storm Drain Inlet Protection - Paved Surface	Trap sediment	Drainage area \leq 1 Ac.	1a	Sediment traps, storm drain diversion
Storm Drain Inlet Protection - Stone and Block	Trap sediment	Drainage area \leq 1 Ac.	2,3,4,6	Sediment traps, storm drain diversion
Straw Bale Dike	Control sediment	2:1 slopes maximum, 25 ft. spacing	All	Silt fence

* See Erosion and Sediment Control Practice Matrix Construction Activity Key on page 2.15

Table 2.4 (Continued)
Erosion and Sediment Control Practices Matrix
Sediment Control (See Section 5)

<u>Practice</u>	<u>Primary Purpose</u>	<u>Site Characteristics</u>	<u>Construction Activity</u>	<u>Associated Practices</u>
Turbidity Curtain	Control sediment	Calm water	1b,1d,1e,1f,5	Sediment traps, basins, seeding, mulching
Water structures/barriers	Control sediment	Large area for placement	1d,1e,1f,5	Armored streambank protection, retaining walls
* See Erosion and Sediment Control Practice Matrix Construction Activity Key on page 2.15				

Table 2.5
Erosion Risk

Soil Type and Parameters	<u>Slope %</u>		
	0-5	5-15	>15
Gravelly, K< 0.35 Non-cohesive PI= NP, Fines: 0-10%	Low	Low	Med
Sandy, K> 0.35 PI= NP, Fines: 0-30%	Med	High	High
Silty, K> 0.35 PI= NP, Fines: 50+%	Med	High	Very High
Clay, K< 0.35 Cohesive PI=7+, Fines: 50+%	Low	Med	High
Dispersive Clay Soils	High	Very High	Extreme
<p>Note: Erosion risk is the probability that the combination of parameters presented will generate a significant amount of soil loss. There are other factors that contribute to erosion, such as slope length and rainfall intensity and duration. Also, even though there may be low erosion risk, there can be a high risk to water quality when the soil disturbance is close to water resources. Each site needs to be evaluated on its own merit to determine actual soil loss. Methodology for this analysis is presented in Appendix A.</p>			

STANDARD AND SPECIFICATIONS FOR CONSTRUCTION ROAD STABILIZATION



Definition & Scope

The stabilization of temporary construction access routes, on-site vehicle transportation routes, and construction parking areas to control erosion on temporary construction routes and parking areas.

Conditions Where Practice Applies

All traffic routes and parking areas for temporary use by construction traffic.

Design Criteria

Construction roads should be located to reduce erosion potential, minimize impact on existing site resources, and maintain operations in a safe manner. Highly erosive soils, wet or rocky areas, and steep slopes should be avoided. Roads should be routed where seasonal water tables are deeper than 18 inches. Surface runoff and control should be in accordance with other standards.

Road Grade – A maximum grade of 12% is recommended, although grades up to 15% are possible for short distances.

Road Width – 12 foot minimum for one-way traffic or 24 foot minimum for two-way traffic.

Side Slope of Road Embankment – 2:1 or flatter.

Ditch Capacity – On-site roadside ditch and culvert capacities shall be the 10 yr. peak runoff.

Composition – Use a 6-inch layer of NYS DOT sub-base Types 1,2,3, 4 or equivalent as specified in NYSDOT Standard Specifications.

Construction Specifications

1. Clear and strip roadbed and parking areas of all vegetation, roots, and other objectionable material.
2. Locate parking areas on naturally flat areas as available. Keep grades sufficient for drainage, but not more than 2 to 3 percent.
3. Provide surface drainage and divert excess runoff to stabilized areas.
4. Maintain cut and fill slopes to 2:1 or flatter and stabilized with vegetation as soon as grading is accomplished.
5. Spread 6-inch layer of sub-base material evenly over the full width of the road and smooth to avoid depressions.
6. Provide appropriate sediment control measures to prevent offsite sedimentation.

Maintenance

Inspect construction roads and parking areas periodically for condition of surface. Top dress with new gravel as needed. Check ditches for erosion and sedimentation after rainfall events. Maintain vegetation in a healthy, vigorous condition. Areas producing sediment should be treated immediately.

STANDARD AND SPECIFICATIONS FOR CONCRETE TRUCK WASHOUT



Definition & Scope

A temporary excavated or above ground lined constructed pit where concrete truck mixers and equipment can be washed after their loads have been discharged, to prevent highly alkaline runoff from entering storm drainage systems or leaching into soil.

Conditions Where Practice Applies

Washout facilities shall be provided for every project where concrete will be poured or otherwise formed on the site. This facility will receive highly alkaline wash water from the cleaning of chutes, mixers, hoppers, vibrators, placing equipment, trowels, and screeds. Under no circumstances will wash water from these operations be allowed to infiltrate into the soil or enter surface waters.

Design Criteria

Capacity: The washout facility should be sized to contain solids, wash water, and rainfall and sized to allow for the evaporation of the wash water and rainfall. Wash water shall be estimated at 7 gallons per chute and 50 gallons per hopper of the concrete pump truck and/or discharging drum. The minimum size shall be 8 feet by 8 feet at the bottom and 2 feet deep. If excavated, the side slopes shall be 2 horizontal to 1 vertical.

Location: Locate the facility a minimum of 100 feet from drainage swales, storm drain inlets, wetlands, streams and other surface waters. Prevent surface water from entering the structure except for the access road. Provide appropriate access with a gravel access road sloped down to the structure. Signs shall be placed to direct drivers to the facility after their load is discharged.

Liner: All washout facilities will be lined to prevent

leaching of liquids into the ground. The liner shall be plastic sheeting with a minimum thickness of 10 mils with no holes or tears, and anchored beyond the top of the pit with an earthen berm, sand bags, stone, or other structural appurtenance except at the access point.

If pre-fabricated washouts are used they must ensure the capture and containment of the concrete wash and be sized based on the expected frequency of concrete pours. They shall be sited as noted in the location criteria.

Maintenance

- All concrete washout facilities shall be inspected daily. Damaged or leaking facilities shall be deactivated and repaired or replaced immediately. Excess rainwater that has accumulated over hardened concrete should be pumped to a stabilized area, such as a grass filter strip.
- Accumulated hardened material shall be removed when 75% of the storage capacity of the structure is filled. Any excess wash water shall be pumped into a containment vessel and properly disposed of off site.
- Dispose of the hardened material off-site in a construction/demolition landfill. On-site disposal may be allowed if this has been approved and accepted as part of the projects SWPPP. In that case, the material should be recycled as specified, or buried and covered with a minimum of 2 feet of clean compacted earthfill that is permanently stabilized to prevent erosion.
- The plastic liner shall be replaced with each cleaning of the washout facility.
- Inspect the project site frequently to ensure that no concrete discharges are taking place in non-designated areas.

STANDARD AND SPECIFICATIONS FOR DUST CONTROL



dust control (see Section 3).

Mulch (including gravel mulch) – Mulch offers a fast effective means of controlling dust. This can also include rolled erosion control blankets.

Spray adhesives – These are products generally composed of polymers in a liquid or solid form that are mixed with water to form an emulsion that is sprayed on the soil surface with typical hydroseeding equipment. The mixing ratios and application rates will be in accordance with the manufacturer's recommendations for the specific soils on the site. In no case should the application of these adhesives be made on wet soils or if there is a probability of precipitation within 48 hours of its proposed use. Material Safety Data Sheets will be provided to all applicators and others working with the material.

Definition & Scope

The control of dust resulting from land-disturbing activities, to prevent surface and air movement of dust from disturbed soil surfaces that may cause off-site damage, health hazards, and traffic safety problems.

Conditions Where Practice Applies

On construction roads, access points, and other disturbed areas subject to surface dust movement and dust blowing where off-site damage may occur if dust is not controlled.

Design Criteria

Construction operations should be scheduled to minimize the amount of area disturbed at one time. Buffer areas of vegetation should be left where practical. Temporary or permanent stabilization measures shall be installed. No specific design criteria is given; see construction specifications below for common methods of dust control.

Water quality must be considered when materials are selected for dust control. Where there is a potential for the material to wash off to a stream, ingredient information must be provided to the NYSDEC.

No polymer application shall take place without written approval from the NYSDEC.

Construction Specifications

A. **Non-driving Areas** – These areas use products and materials applied or placed on soil surfaces to prevent airborne migration of soil particles.

Vegetative Cover – For disturbed areas not subject to traffic, vegetation provides the most practical method of

B. **Driving Areas** – These areas utilize water, polymer emulsions, and barriers to prevent dust movement from the traffic surface into the air.

Sprinkling – The site may be sprayed with water until the surface is wet. This is especially effective on haul roads and access route to provide short term limited dust control.

Polymer Additives – These polymers are mixed with water and applied to the driving surface by a water truck with a gravity feed drip bar, spray bar or automated distributor truck. The mixing ratios and application rates will be in accordance with the manufacturer's recommendations. Incorporation of the emulsion into the soil will be done to the appropriate depth based on expected traffic. Compaction after incorporation will be by vibratory roller to a minimum of 95%. The prepared surface shall be moist and no application of the polymer will be made if there is a probability of precipitation within 48 hours of its proposed use. Material Safety Data Sheets will be provided to all applicators working with the material.

Barriers – Woven geo-textiles can be placed on the driving surface to effectively reduce dust throw and particle migration on haul roads. Stone can also be used for construction roads for effective dust control.

Windbreak – A silt fence or similar barrier can control air currents at intervals equal to ten times the barrier height. Preserve existing wind barrier vegetation as much as practical.

Maintenance

Maintain dust control measures through dry weather periods until all disturbed areas are stabilized.

STANDARD AND SPECIFICATIONS FOR PROTECTING VEGETATION DURING CONSTRUCTION



Definition & Scope

The protection of trees, shrubs, ground cover and other vegetation from damage by construction equipment. In order to preserve existing vegetation determined to be important for soil erosion control, water quality protection, shade, screening, buffers, wildlife habitat, wetland protection, and other values.

Conditions Where Practices Applies

On planned construction sites where valued vegetation exists and needs to be preserved.

Design Criteria

1. Planning Considerations

A. Inventory:

1) Property boundaries, topography, vegetation and soils information should be gathered. Identify potentially high erosion areas, areas with tree windthrow potential, etc. A vegetative cover type map should be made on a copy of a topographic map which shows other natural and manmade features. Vegetation that is desirable to preserve because of its value for screening, shade, critical erosion control, endangered species, aesthetics, etc., should be identified and marked on the map.

2) Based upon this data, general statements should be prepared about the present condition, potential problem areas, and unique features of the property.

B. Planning:

1) After engineering plans (plot maps) are prepared, another field review should take place and

recommendations made for the vegetation to be saved. Minor adjustments in location of roads, dwellings, and utilities may be needed. Construction on steep slopes, erodible soils, wetlands, and streams should be avoided. Clearing limits should be delineated (See "Determine Limits of Clearing and Grading" on page 2.2).

2) Areas to be seeded and planted should be identified. Remaining vegetation should blend with their surroundings and/or provide special function such as a filter strip, buffer zone, or screen.

3) Trees and shrubs of special seasonal interest, such as flowering dogwood, red maple, striped maple, serviceberry, or shadbush, and valuable potential shade trees should be identified and marked for special protective treatment as appropriate.

4) Trees to be cut should be marked on the plans. If timber can be removed for salable products, a forester should be consulted for marketing advice.

5) Trees that may become a hazard to people, personal property, or utilities should be removed. These include trees that are weak-wooded, disease-prone, subject to windthrow, or those that have severely damaged root systems.

6) The vigor of remaining trees may be improved by a selective thinning. A forester should be consulted for implementing this practice.

2. Measures to Protect Vegetation

A. Limit soil placement over existing tree and shrub roots to a maximum of 3 inches. Soils with loamy texture and good structure should be used.

B. Use retaining walls and terraces to protect roots of trees and shrubs when grades are lowered. Lowered grades should start no closer than the dripline of the tree. For narrow-canopied trees and shrubs, the stem diameter in inches is converted to feet and doubled, such that a 10 inch tree should be protected to 20 feet.

C. Trenching across tree root systems should be the same minimum distance from the trunk, as in "B". Tunnels under root systems for underground utilities should start 18 inches or deeper below the normal ground surface. Tree roots which must be severed should be cut clean. Backfill material that will be in contact with the roots should be topsoil or a prepared planting soil mixture.

D. Construct sturdy fences, or barriers, of wood, steel, or other protective material around valuable

vegetation for protection from construction equipment. Place barriers far enough away from trees, but not less than the specifications in "B", so that tall equipment such as backhoes and dump trucks do not contact tree branches.

E. Construction limits should be identified and clearly marked to exclude equipment.

F. Avoid spills of oil/gas and other contaminants.

G. Obstructive and broken branches should be pruned properly. The branch collar on all branches whether living or dead should not be damaged. The 3 or 4 cut method should be used on all branches larger than two inches at the cut. First cut about one-third the way through the underside of the limb (about 6-12 inches from the tree trunk). Then (approximately an inch further out) make a second cut through the limb from the upper side. When the branch is removed, there is no splintering of the main tree trunk. Remove the stub. If the branch is larger than 5-6 inches in diameter, use the four cut system. Cuts 1 and 2 remain the same and cut 3 should be from the underside of the limb, on the outside of the branch collar. Cut 4 should be from the top and in alignment with the 3rd cut. Cut 3 should be 1/4 to 1/3 the way through the limb. This will prevent the bark from peeling down the trunk. Do not paint the cut surface.

H. Penalties for damage to valuable trees, shrubs, and herbaceous plants should be clearly spelled out in the contract.

PROTECTING TREES IN HEAVY USE AREAS

The compaction of soil over the roots of trees and shrubs by the trampling of recreationists, vehicular traffic, etc., reduces oxygen, water, and nutrient uptake by feeder roots. This weakens and may eventually kill the plants. Table 2.6 rates the "Susceptibility of Tree Species to Compaction."

Where heavy compaction is anticipated, apply and maintain a 3 to 4 inch layer of undecayed wood chips or 2 inches of No. 2 washed, crushed gravel. In addition, use of a wooden or plastic mat may be used to lessen compaction, if applicable.

Table 2.6 Susceptibility of Tree Species to Compaction¹

Resistant:

Box elder.....	<i>Acer negundo</i>	Willows.....	<i>Salix spp.</i>
Green ash.....	<i>Fraxinus pennsylvanica</i>	Honey locust.....	<i>Gleditsia triacanthos</i>
Red elm.....	<i>Ulmus rubra</i>	Eastern cottonwood.....	<i>Populus deltoides</i>
Hawthornes.....	<i>Crataegus spp.</i>	Swamp white oak.....	<i>Quercus bicolor</i>
Bur oak.....	<i>Quercus macrocarpa</i>	Hophornbeam.....	<i>Ostrya virginiana</i>
Northern white cedar....	<i>Thuja occidentalis</i>		

Intermediate:

Red maple.....	<i>Acer rubrum</i>	Sweetgum.....	<i>Liquidambar styraciflua</i>
Silver maple.....	<i>Acer saccharinum</i>	Norway maple.....	<i>Acer platanoides</i>
Hackberry.....	<i>Celtis occidentalis</i>	Shagbark hickory.....	<i>Carya ovata</i>
Black gum.....	<i>Nyssa sylvatica</i>	London plane.....	<i>Platanus x hybrida</i>
Red oak.....	<i>Quercus rubra</i>	Pin oak.....	<i>Quercus palustris</i>
Basswood.....	<i>Tilia americana</i>		

Susceptible:

Sugar maple.....	<i>Acer saccharum</i>	Austrian Pine.....	<i>Pinus nigra</i>
White pine.....	<i>Pinus strobus</i>	White ash.....	<i>Fraxinus americana</i>
Blue spruce.....	<i>Picea pungens</i>	Paper birch.....	<i>Betula papyrifera</i>
White oak.....	<i>Quercus alba</i>	Moutain ash.....	<i>Sorbus aucuparia</i>
Red pine.....	<i>Pinus resinosa</i>	Japanese maple.....	<i>Acer palmatum</i>

¹ If a tree species does not appear on the list, insufficient information is available to rate it for this purpose.

STANDARD AND SPECIFICATIONS FOR SITE POLLUTION PREVENTION



Definition & Scope

A collection of management practices intended to control non-sediment pollutants associated with construction activities to prevent the generation of pollutants due to improper handling, storage, and spills and prevent the movement of toxic substances from the site into surface waters.

Conditions Where Practice Applies

On all construction sites where the earth disturbance exceeds 5,000 square feet, and involves the use of fertilizers, pesticides, petroleum based chemicals, fuels and lubricants, as well as sealers, paints, cleared woody vegetation, garbage, and sanitary wastes.

Design Criteria

The variety of pollutants on a particular site and the severity of their impacts depend on factors such as the nature of the construction activity, the physical characteristics of the construction site, and the proximity of water bodies and conveyances to the pollutant source.

1. All state and federal regulations shall be followed for the storage, handling, application, usage, and disposal of pesticides, fertilizers, and petroleum products.
2. Vehicle and construction equipment staging and maintenance areas will be located away from all drainage ways with their parking areas graded so the runoff from these areas is collected, contained and treated prior to discharge from the site.
3. Provide sanitary facilities for on-site personnel.
4. Store, cover, and isolate construction materials including topsoil, and chemicals, to prevent runoff of

pollutants and contamination of groundwater and surface waters.

5. Develop and implement a spill prevention and control plan. The plan should include NYSDEC's spill reporting and initial notification requirements.
6. Provide adequate disposal for solid waste including woody debris, stumps, and other construction waste and include these methods and directions in the construction details on the site construction drawings. Fill, woody debris, stumps and construction waste shall not be placed in regulated wetlands, streams or other surface waters.
7. Distribute or post informational material regarding proper handling, spill response, spill kit location, and emergency actions to be taken, to all construction personnel.
8. Refueling equipment shall be located at least 100 feet from all wetlands, streams and other surface waters.



STANDARD AND SPECIFICATIONS FOR STABILIZED CONSTRUCTION ACCESS



inert to commonly encountered chemicals, hydro-carbons, mildew, rot resistant, and conform to the fabric properties as shown:

Fabric Properties ³	Light Duty ¹ Roads Grade Sub- grade	Heavy Duty ² Haul Roads Rough Graded	Test Meth- od
Grab Tensile Strength (lbs)	200	220	ASTM D1682
Elongation at Failure (%)	50	60	ASTM D1682
Mullen Burst Strength (lbs)	190	430	ASTM D3786
Puncture Strength (lbs)	40	125	ASTM D751 Modified
Equivalent	40-80	40-80	US Std Sieve
Opening Size			CW-02215
Aggregate Depth	6	10	-

Definition & Scope

A stabilized pad of aggregate underlain with geotextile located at any point where traffic will be entering or leaving a construction site to or from a public right-of-way, street, alley, sidewalk, or parking area. The purpose of stabilized construction access is to reduce or eliminate the tracking of sediment onto public rights-of-way or streets.

Conditions Where Practice Applies

A stabilized construction access shall be used at all points of construction ingress and egress.

Design Criteria

See Figure 2.1 on page 2.31 for details.

Aggregate Size: Use a matrix of 1-4 inch stone, or reclaimed or recycled concrete equivalent.

Thickness: Not less than six (6) inches.

Width: 12-foot minimum but not less than the full width of points where ingress or egress occurs. 24-foot minimum if there is only one access to the site.

Length: As required, but not less than 50 feet (except on a single residence lot where a 30 foot minimum would apply).

Geotextile: To be placed over the entire area to be covered with aggregate. Filter cloth will not be required on a single-family residence lot. Piping of surface water under entrance shall be provided as required. If piping is impossible, a mountable berm with 5:1 slopes will be permitted.

Criteria for Geotextile: The geotextile shall be woven or nonwoven fabric consisting only of continuous chain polymeric filaments or yarns of polyester. The fabric shall be

¹Light Duty Road: Area sites that have been graded to subgrade and where most travel would be single axle vehicles and an occasional multi-axle truck. Acceptable materials are Trevira Spunbond 1115, Mirafi 100X, Typar 3401, or equivalent.

²Heavy Duty Road: Area sites with only rough grading, and where most travel would be multi-axle vehicles. Acceptable materials are Trevira Spunbond 1135, Mirafi 600X, or equivalent.

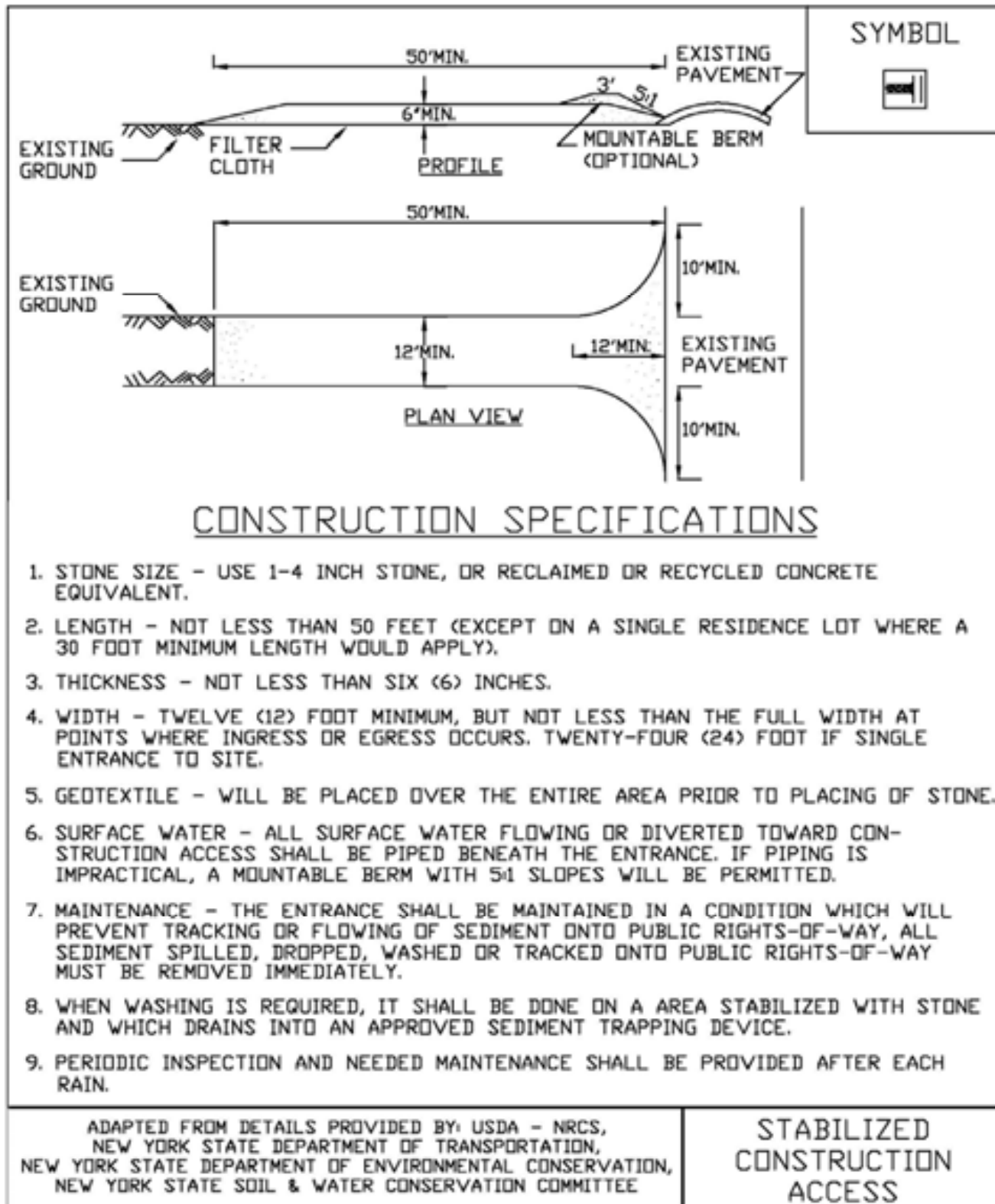
³Fabrics not meeting these specifications may be used only when design procedure and supporting documentation are supplied to determine aggregate depth and fabric strength.

Maintenance

The access shall be maintained in a condition which will prevent tracking of sediment onto public rights-of-way or streets. This may require periodic top dressing with additional aggregate. All sediment spilled, dropped, or washed onto public rights-of-way must be removed immediately.

When necessary, wheels must be cleaned to remove sediment prior to entrance onto public rights-of-way. When washing is required, it shall be done on an area stabilized with aggregate, which drains into an approved sediment-trapping device. All sediment shall be prevented from entering storm drains, ditches, or watercourses.

**Figure 2.1
Stabilized Construction Access**



STANDARD AND SPECIFICATIONS FOR TEMPORARY ACCESS WATERWAY CROSSING



Definition & Scope

A temporary access waterway crossing is a structure placed across a waterway to provide access for construction purposes for a period of less than one year. Consideration should be given to stream flow capacity and velocity anticipated during the period of time that the temporary structures will be in place. Temporary access crossings shall not be utilized to maintain traffic for the general public. The purpose of the temporary access waterway crossing is to provide safe, environmentally sound access across a waterway for construction equipment by establishing minimum standards and specifications for the design, construction, maintenance, and removal of the structure. This standard and specification may represent a channel constriction, thus, the temporary nature of waterway access crossing must be stressed. They should be planned to be in service for the shortest practical period of time and removed as soon as their function is completed.

Conditions Where Practice Applies

This standard and specification for temporary access waterway crossings is applicable in non-tidal waterways. It provides designs based on waterway geometry rather than the drainage area contributing to the point of crossing.

The principal consideration for development of the standard and specifications is concern for erosion and sediment control, tracking soil into waterways, blocking fish passage and destruction of aquatic habitat. Structural utility and safety must also be considered when designing temporary access waterway crossings to withstand expected loads.

The three types of standard temporary access

waterway crossings are bridges, culverts, and fords.

General Requirements

1. **In-Stream Excavation:** In-Stream excavation shall be limited to only that necessary to allow installation of the standard methods as presented in Subsection “Temporary Access Waterway Crossing Methods.”
2. **Elimination of Fish Migration Barriers:** Of the two basic methods presented in Subsection “Temporary Access Waterway Crossing Methods,” bridges pose the least potential for creating barriers to aquatic migration. The construction of any specific crossing method as presented in Subsection “Temporary Access Waterway Crossing Methods,” shall not cause a significant water level difference between the upstream and downstream water surface elevations. Fish spawning or migration within waterways generally occurs between October 1 to May 31 for water classified for trout and from March 15 to July 15 for other streams. Fish spawning or migration dates can vary across New York and restrictions imposed by the NYS Department of Environmental Conservation may vary and must be checked.
3. **Crossing Alignment:** The temporary waterway crossing shall be at right angles to the stream. Where approach conditions dictate, the crossing may vary 15 degrees from a line drawn perpendicular to the centerline of the stream at the intended crossing location.
4. **Road Approaches:** The centerline of both roadway approaches shall coincide with the crossing alignment centerline for a minimum distance of 50 feet from each bank of the waterway being crossed. If physical or right-of-way restraints preclude the 50 feet minimum, a shorter distance may be provided. All fill materials associated with the roadway approach shall be limited to a maximum height of 2 feet above the existing flood plain elevation.
5. **Surface Water Diverting Structure:** A water diverting structure such as a swale shall be constructed (across the roadway on both roadway approaches) 50 feet (maximum) on either side of the waterway crossing. This will prevent roadway surface runoff from directly entering the waterway. The 50 feet is measured from the top of the waterway bank. Design criteria for this diverting structure shall be in accordance with the “Standard and Specification” for

the individual design standard of choice. If the roadway approach is constructed with a reverse grade away from the waterway, a separate diverting structure is not required.

6. **Road Width:** All crossings shall have one traffic lane. The minimum width shall be 12 feet with a maximum width of 20 feet.

7. **Time of Operation:** All temporary crossing shall be removed within 14 calendar days after the structure is no longer needed. Unless prior written approval is obtained, all structures shall be removed within one year from the date of the installation.

8. **Materials**

A. **Aggregate:** There shall be no earth or soil materials used for construction within the waterway channel. NYS DOT specifications for coarse aggregate designation No. 4 (2" to 4"), also referenced as AASHTO designation No. 1, shall be the minimum acceptable aggregate size for temporary crossings. Larger aggregates will be allowed.

B. **Filter Cloth:** Filter cloth is a fabric consisting of either woven or nonwoven plastic, polypropylene, or nylon used to distribute the load, retain fines, allow increased drainage of the aggregate and reduce mixing of the aggregate with the subgrade soil. The designer shall specify the appropriate filter fabric/cloth for a specific use.

Temporary Access Waterway Crossing Methods

The following criteria for erosion and sediment control shall be considered when selecting a specific temporary access waterway crossing standard method:

1. **Site aesthetics:** Select a standard design method that will least disrupt the existing terrain of the stream reach. Consider the effort that will be required to restore the area after the temporary crossing is removed.
2. **Site location:** Locate the temporary crossing where there will be the least disturbance to the soils of the existing waterway banks. When possible, locate the crossing at a point receiving minimal surface runoff.
3. **Physical site constraints:** The physical constraints of a site may preclude the selection of one or more of the standard methods.
4. **Time of year:** The time of year may preclude the selection of one or more of the standard methods due to fish spawning or migration restrictions.

5. **Vehicular loads and traffic patterns:** Vehicular loads, traffic patterns, and frequency of crossing should be considered in choosing a specific method.

6. **Maintenance of crossing:** The standard methods will require various amounts of maintenance. The bridge method should require the least maintenance, whereas the ford method will probably require more intensive maintenance.

7. **Removal of the Structure:** Ease of removal and subsequent damage to the waterway should be primary factors in considering the choice of a standard method.

Temporary Access Bridge (Figure 2.2 on page 2.36)

A temporary access bridge is a structure made of wood, metal, or other materials, which provides access across a stream or waterway.

Considerations:

1. This is the preferred method for temporary access waterway crossings. Normally, bridge construction causes the least disturbance to the waterway bed and banks when compared to the other access waterway crossings.
2. Most bridges can be quickly removed and reused.
3. Temporary access bridges pose the least chance for interference with fish migration when compared to the other temporary access waterway crossings.
4. Span width will be limited by the length of the bridging material and weight of equipment that will drive over the temporary bridge. Spans of over 10 feet are difficult to construct.
5. **Restrictions and Permits:** A permit from the New York State Department of Environmental Conservation, Division of Environmental Permits, Regional Permit Administrator, will be needed to install and remove temporary access culverts in streams with a classification of C(T) and higher. Installation and removal may not be permitted during the period of time from the start of trout spawning until the eggs have hatched. In some instances, restrictions may also be applied to bass spawning waters.

Construction Specifications:

1. **Restriction:** Construction, use, or removal of a temporary access bridge will not normally have any time of year restrictions if construction, use, or

removal does not disturb the stream or its banks.

2. **Bridge Placement:** A temporary bridge structure shall be constructed at or above bank elevation to prevent the entrapment of floating materials and debris.

3. **Abutments:** Abutments shall be placed parallel to and on stable banks.

4. **Bridge Span:** Bridges shall be constructed to span the entire channel. If a footing, pier, or bridge support is constructed within the waterway, a stream-disturbance permit may be required.

5. **Stringers:** Stringers shall either be logs, saw timber, pre-stressed concrete beams, metal beams, or other approved materials.

6. **Deck Material:** Decking shall be of sufficient strength to support the anticipated load. All decking members shall be placed perpendicular to the stringers, butted tightly, and securely fastened to the stringers. Decking materials must be butted tightly to prevent any soil material tracked onto the bridge from falling into the waterway below.

7. **Run Planks (optional):** Run planking shall be securely fastened to the length of the span. One run plank shall be provided for each track of the equipment wheels. Although run planks are optional, they may be necessary to properly distribute loads.

8. **Curbs or Fenders:** Curbs or fenders may be installed along the outer sides of the deck. Curbs or fenders are an option, which will provide additional safety.

9. **Bridge Anchors:** Bridges shall be securely anchored at only one end using steel cable or chain. Anchoring at only one end will prevent channel obstruction in the event that floodwaters float the bridge. Acceptable anchors are large trees, large boulders, or driven steel anchors. Anchoring shall be sufficient to prevent the bridge from floating downstream and possibly causing an obstruction to the flow.

10. **Stabilization:** All areas disturbed during installation shall be stabilized within 14 calendar days of that disturbance in accordance with the Standard and Specification for Temporary Construction Area Seeding on page 4.58.

Bridge Maintenance Requirements

1. **Inspection:** Periodic inspection shall be performed by the user to ensure that the bridge, streambed, and streambanks are maintained and not damaged.

2. **Maintenance:** Maintenance shall be performed, as needed to ensure that the structure complies with the standard and specifications. This shall include removal and disposal of any trapped sediment or debris. Sediment shall be disposed of outside of the floodplain and stabilized.

Bridge Removal and Clean-Up Requirements

1. **Removal:** When the temporary bridge is no longer needed, all structures including abutments and other bridging materials shall be removed within 14 calendar days. In all cases, the bridge materials shall be removed within one year of installation.

2. **Final Clean-Up:** Final clean-up shall consist of removal of the temporary bridge from the waterway, protection of banks from erosion, and removal of all construction materials. All removed materials shall be stored outside the waterway floodplain.

3. **Method:** Removal of the bridge and clean-up of the area shall be accomplished without construction equipment working in the waterway channel.

4. **Final Stabilization:** All areas disturbed during removal shall be stabilized within 14 calendar days of that disturbance in accordance with the Standard and Specifications for Permanent Construction Area Planting on page 4.42.

Temporary Access Culvert (Figure 2.3 on page 2.37)

A temporary access culvert is a structure consisting of a section(s) of circular pipe, pipe arches, or oval pipes of reinforcing concrete, corrugated metal, or structural plate, which is used to convey flowing water through the crossing.

Considerations

1. Temporary culverts are used where a) the channel is too wide for normal bridge construction, b) anticipated loading may prove unsafe for single span bridges, or c) access is not needed from bank to bank.

2. This temporary waterway crossing method is normally preferred over a ford type of crossing, since disturbance to the waterway is only during construction and removal of the culvert.

3. Temporary culverts can be salvaged and reused.

Construction Specifications

1. **Restrictions and Permits:** A permit from the New York State Department of Environmental

Conservation, Division of Environmental Permits, Regional Permit Administrator, will be needed to install and remove temporary access culverts in streams with a classification of C(T) and higher. Installation and removal may not be permitted during the period of time from the start of trout spawning until the eggs have hatched. In some instances, restrictions may also be applied to bass spawning waters.

2. Culvert Strength: All culverts shall be strong enough to support their cross sectional area under maximum expected loads.

3. Culvert Size: The size of the culvert pipe shall be the largest pipe diameter that will fit into the existing channel without major excavation of the waterway channel or without major approach fills. If a channel width exceeds 3 feet, additional pipes may be used until the cross sectional area of the pipes is greater than 60 percent of the cross sectional area of the existing channel. The minimum size culvert that may be used is 12-inch diameter pipe.

4. Culvert Length: The culvert(s) shall extend a minimum of one foot beyond the upstream and downstream toe of the aggregate placed around the culvert. In no case shall the culvert exceed 40 feet in length.

5. Filter Cloth: Filter cloth shall be placed on the streambed and streambanks prior to placement of the pipe culvert(s) and aggregate. The filter cloth shall cover the streambed and extend a minimum six inches and a maximum one foot beyond the end of the culvert and bedding material. Filter cloth reduces settlement and improves crossing stability.

6. Culvert Placement: The invert elevation of the culvert shall be installed on the natural streambed grade to minimize interference with fish migration (free passage of fish).

7. Culvert Protection: The culvert(s) shall be covered with a minimum of one foot of aggregate. If multiple culverts are used, they shall be separated by at least 12 in. of compacted aggregate fill. At the minimum, the bedding and fill material used in the construction of the temporary access culvert crossings shall conform with the aggregate requirements cited in the General Requirements subsection.

8. Stabilization: All areas disturbed during culvert installation shall be stabilized within 14 calendar days of the disturbance in accordance with the Standard for Permanent Construction Area Plantings.

ensure that the culverts, streambed, and streambanks are not damaged, and that sediment is not entering the stream or blocking fish passage or migration.

2. Maintenance: Maintenance shall be performed, as needed in a timely manner to ensure that structures are in compliance with this standard and specification. This shall include removal and disposal of any trapped sediment or debris. Sediment shall be disposed of and stabilized outside the waterway flood plain.

Culvert Removal and Clean-Up Requirements

1. Removal: When the crossing has served its purpose, all structures, including culverts, bedding, and filter cloth materials shall be removed within 14 calendar days. In all cases, the culvert materials shall

be removed within one year of installation. No structure shall be removed during the spawning season (generally October 1 through May 31 for trout waters and March 15 through July 15 for other waters).

2. Final Clean-Up: Final clean-up shall consist of removal of the temporary structure from the waterway, removal of all construction materials, restoration of original stream channel cross section, and protection of the streambanks from erosion. Removed material shall be stored outside of the waterway floodplain.

3. Method: Removal of the structure and clean-up of the area shall be accomplished without construction equipment working in the waterway channel.

4. Final Stabilization: All areas disturbed during culvert removal shall be stabilized within 14 calendar days of the disturbance in accordance with the Standard for Permanent Construction Area Plantings.

NOTE: Any temporary access crossing shall conform to the technical requirements of this Standard and Specifications as well as any specific requirement imposed by the New York State Department of Environmental Conservation and the US Army Corps of Engineers. Permits may be required for streambank disturbance.

Culvert Maintenance Requirements

1. Inspection: Periodic inspection shall be performed to

Figure 2.2
Temporary Access Bridge

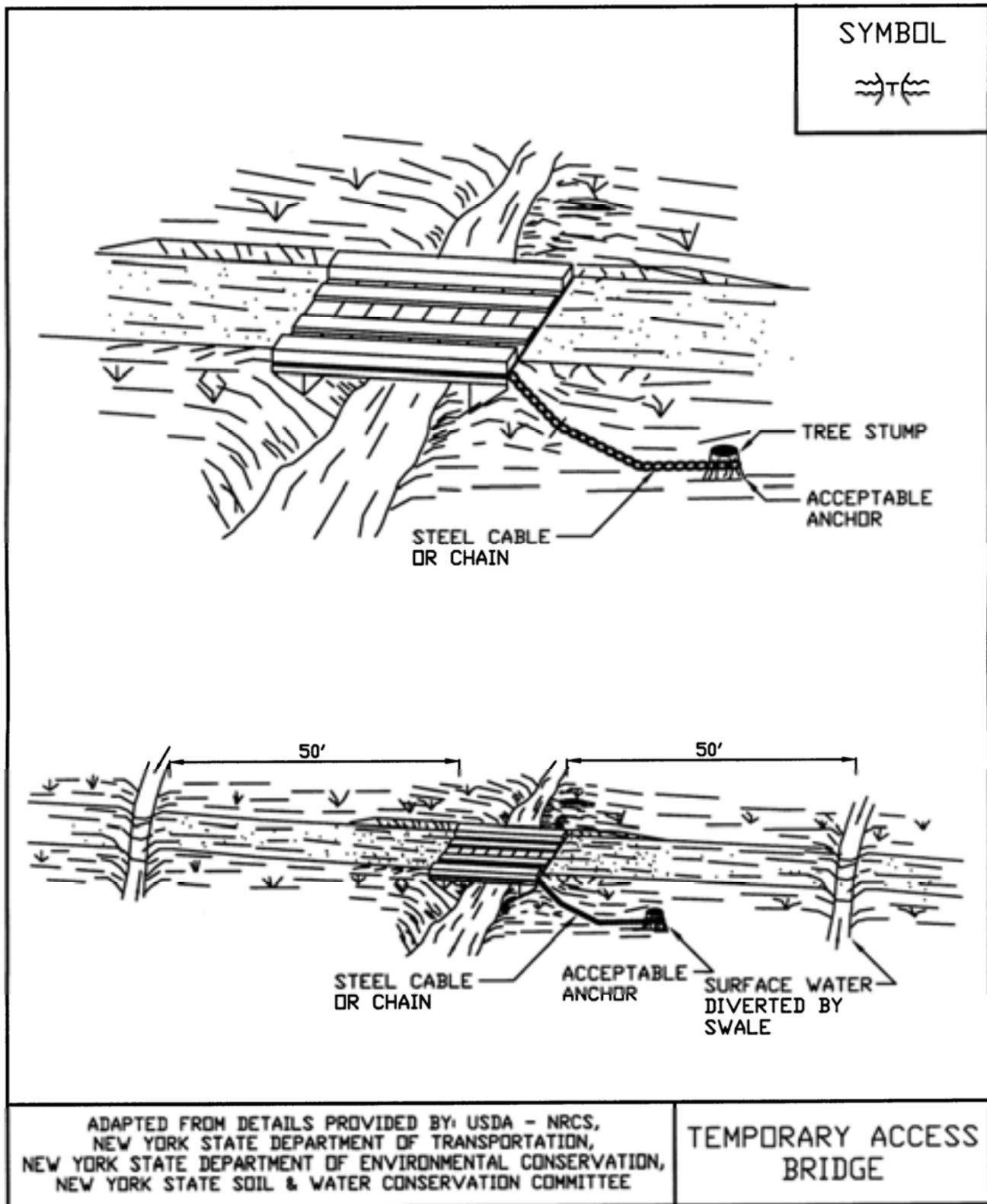
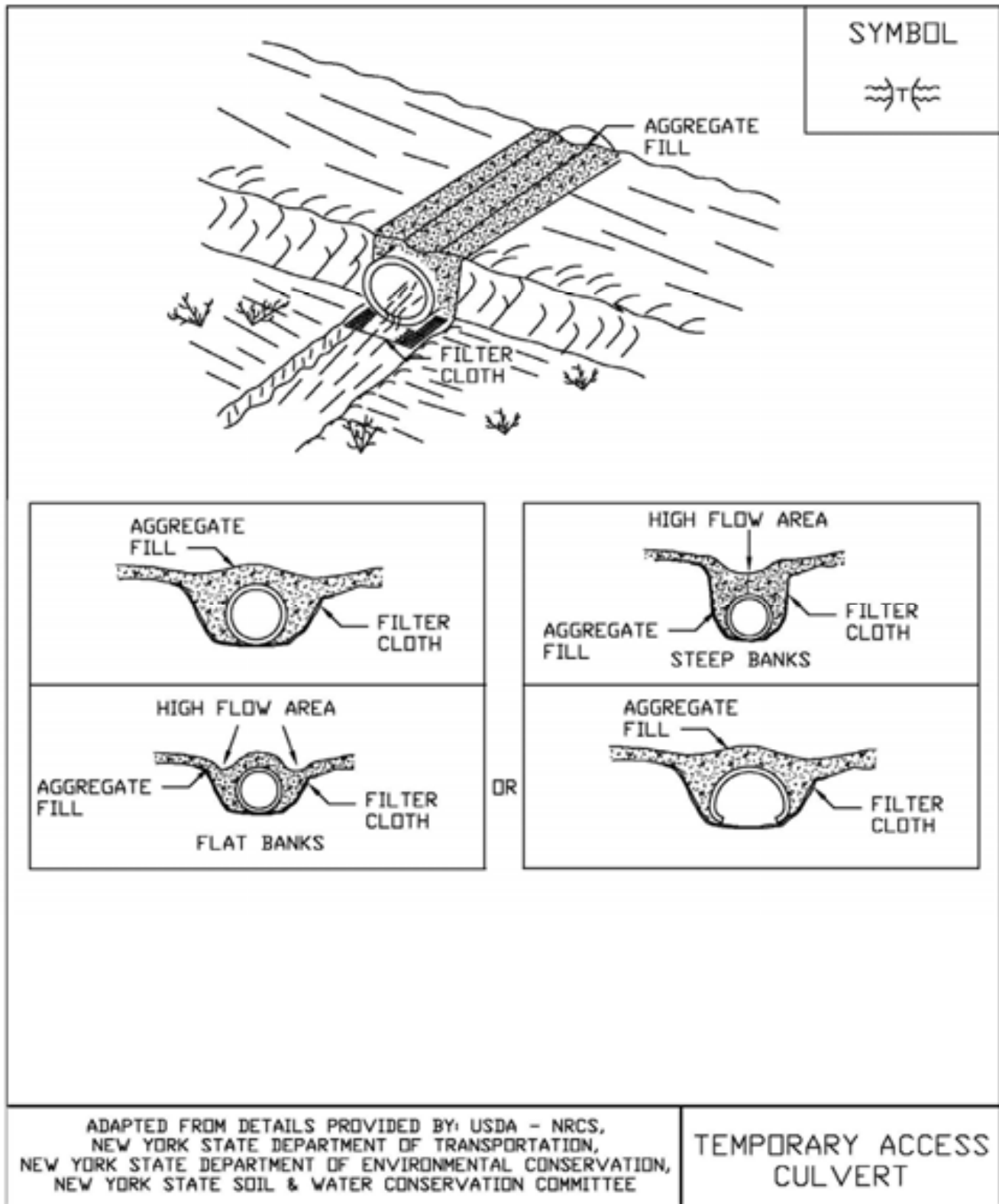


Figure 2.3
Temporary Access Culvert



STANDARD AND SPECIFICATIONS FOR WINTER STABILIZATION



Definition & Scope

A temporary site specific, enhanced erosion and sediment control plan to manage runoff and sediment at the site during construction activities in the winter months to protect off-site water resources.

Conditions Where Practice Applies

This standard applies to all construction activities involved with ongoing land disturbance and exposure between November 15th to the following April 1st.

Design Criteria

1. Prepare a snow management plan with adequate storage for snow and control of melt water, requiring cleared snow to be stored in a manner not affecting ongoing construction activities.
2. Enlarge and stabilize access points to provide for snow management and stockpiling. Snow management activities must not destroy or degrade installed erosion and sediment control practices.
3. A minimum 25 foot buffer shall be maintained from all perimeter controls such as silt fence. Mark silt fence with tall stakes that are visible above the snow pack.
4. Edges of disturbed areas that drain to a waterbody within 100 feet will have 2 rows of silt fence, 5 feet apart, installed on the contour.
5. Drainage structures must be kept open and free of snow and ice dams. All debris, ice dams, or debris from plowing operations, that restrict the flow of runoff and meltwater, shall be removed.
6. Sediment barriers must be installed at all appropriate

perimeter and sensitive locations. Silt fence and other practices requiring earth disturbance must be installed before the ground freezes.

7. Soil stockpiles must be protected by the use of established vegetation, anchored straw mulch, rolled stabilization matting, or other durable covering. A barrier must be installed at least 15 feet from the toe of the stockpile to prevent soil migration and to capture loose soil.
8. In areas where soil disturbance activity has temporarily or permanently ceased, the application of soil stabilization measures should be initiated by the end of the next business day and completed within three (3) days. Rolled erosion control blankets must be used on all slopes 3 horizontal to 1 vertical or steeper.
9. If straw mulch alone is used for temporary stabilization, it shall be applied at double the standard rate of 2 tons per acre, making the application rate 4 tons per acre. Other manufactured mulches should be applied at double the manufacturer's recommended rate.
10. To ensure adequate stabilization of disturbed soil in advance of a melt event, areas of disturbed soil should be stabilized at the end of each work day unless:
 - a. work will resume within 24 hours in the same area and no precipitation is forecast or;
 - b. the work is in disturbed areas that collect and retain runoff, such as open utility trenches, foundation excavations, or water management areas.
11. Use stone paths to stabilize access perimeters of buildings under construction and areas where construction vehicle traffic is anticipated. Stone paths should be a minimum 10 feet in width but wider as necessary to accommodate equipment.

Maintenance

The site shall be inspected frequently to ensure that the erosion and sediment control plan is performing its winter stabilization function. If the site will not have earth disturbing activities ongoing during the "winter season", **all** bare exposed soil must be stabilized by established vegetation, straw or other acceptable mulch, matting, rock, or other approved material such as rolled erosion control products. Seeding of areas with mulch cover is preferred but seeding alone is not acceptable for proper stabilization.

Compliance inspections must be performed and reports filed properly in accordance with the SWPPP for all sites under a winter shutdown.

References

1. Northeastern Illinois Soil and Sedimentation Control Steering Committee. October 1981. Procedures and Standards for Urban Soil Erosion and Sediment Control in Illinois.
2. J.F. Rushing, V.M. Moore, J.S. Tingle, Q. Mason, and T. McCaffery, 2005. Dust Abatement Methods for Lines of Communication and Base Camps in Temperate Climates. ERDC/GSL TR-05-23, October 2005.

**SECTION 3
EROSION CONTROL - PART 1
RUNOFF CONTROL**

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EROSION CONTROL - PART 1

RUNOFF CONTROL

Scope and Discussion

Water management on and above potentially eroding sites is extremely important and is the first step in controlling potential erosion on construction sites or disturbed, exposed soil areas. Large watersheds above a site may require extensive water control measures. Water flow paths must be controlled to allow safe delivery of water to an outlet at the side or bottom of a slope. Shallow ditches or diversions across the slope and above the area to be disturbed is an effective method of avoiding rills and gullies in disturbed areas and wash-out of the seed and soil. Diversions may be constructed at a point where surface runoff water is intercepted and carried away from the slope to a safe outlet.

Within the construction area, surface runoff and groundwater must be managed to protect both the site condition and offsite resources. Conveyances such as swales, waterways, slope drains, dewatering methods and flow bypass systems need to be evaluated to meet design objectives. These include both the management of clean water as well as sediment laden water. **In all cases, water management practices should take into account potential impacts to receiving waters and include stable discharge elements.** This may include armored or fabric lined conveyances, rock outlet aprons, flow dissipation, or excavated plunge pools.

On large slopes benching may be necessary for drainage and/or future maintenance access (see standard for Land Grading). Subsurface drainage is frequently included to prevent long term saturated soil conditions and sloughing.

Structural erosion control practices are generally considered as temporary or permanent depending on how they are used. Some are both. Temporary structural practices are used during construction to prevent onsite erosion and offsite migration of sediment. The length of time that temporary practices are functional varies from project to project, since the sediment control strategy may change as construction activity progresses. Permanent structural practices are used to convey surface water runoff to a safe outlet. They will remain in place and continue to function after the completion of construction and final stabilization.

Regardless of whether the practices are temporary or permanent, runoff control measures should be the first practices constructed when grading begins, and be completely functional before downslope land disturbance takes place. Earthen structures such as diversions, dikes, and swales must be stabilized before being considered functional. Only after runoff control structures are operational and sediment control measures in place, should clearing and grading on the rest of the construction site begin.

Note: Performing activities within or adjacent to wetlands, streams and waterbodies may require permits from the New York State Department of Environmental Conservation (NYSDEC) pursuant to Article 15 (Protection of Waters), Article 24 (Freshwater Wetlands) and Article 25 (Tidal Wetlands) of the Environmental Conservation Law (ECL). Project owners should contact NYSDEC's Regional Division of Environmental Permits early in the site planning process to discuss the requirements for meeting permit issuance standards. Following the New York State Standards and Specifications for Erosion and Sediment Control may not ensure compliance with the above referenced sections of the ECL.

STANDARD AND SPECIFICATIONS FOR CHECK DAM



Definition & Scope

Small barriers or dams constructed of stone, bagged sand or gravel, or other durable materials across a drainageway to reduce erosion in a drainage channel by reducing the velocity of flow in the channel.

Conditions Where Practice Applies

This practice is used as a **temporary** and, in some cases, a **permanent** measure to limit erosion by reducing velocities in open channels that are degrading or subject to erosion or where permanent stabilization is impractical due to short period of usefulness and time constraints of construction.

Design Criteria

Drainage Area: Maximum drainage area above the check dam shall not exceed two (2) acres.

Height: Not greater than 2 feet. Center shall be maintained 9 inches lower than abutments at natural ground elevation.

Side Slopes: Shall be 2:1 or flatter.

Spacing: The check dams shall be spaced as necessary in the channel so that the crest of the downstream dam is at the elevation of the toe of the upstream dam. This spacing is equal to the height of the check dam divided by the channel slope.

Therefore:
$$S = \frac{h}{s}$$

Where: S = spacing interval (ft.)
h = height of check dam (ft.)
s = channel slope (ft./ft.)

Example:

For a channel with and 2 ft. high stone they are spaced as
$$S = \frac{2 \text{ ft}}{0.04 \frac{\text{ft}}{\text{ft}}} = 50 \text{ ft}$$
 a 4% slope check dams, follows:

For stone check dams: Use a well graded stone matrix 2 to 9 inches in size (NYS – DOT Light Stone Fill meets these requirements).

The overflow of the check dams will be stabilized to resist erosion that might be caused by the check dam. See Figure 3.1 on page 3.3 for details.

Check dams should be anchored in the channel by a cutoff trench 1.5 ft. wide and 0.5 ft. deep and lined with filter fabric to prevent soil migration.

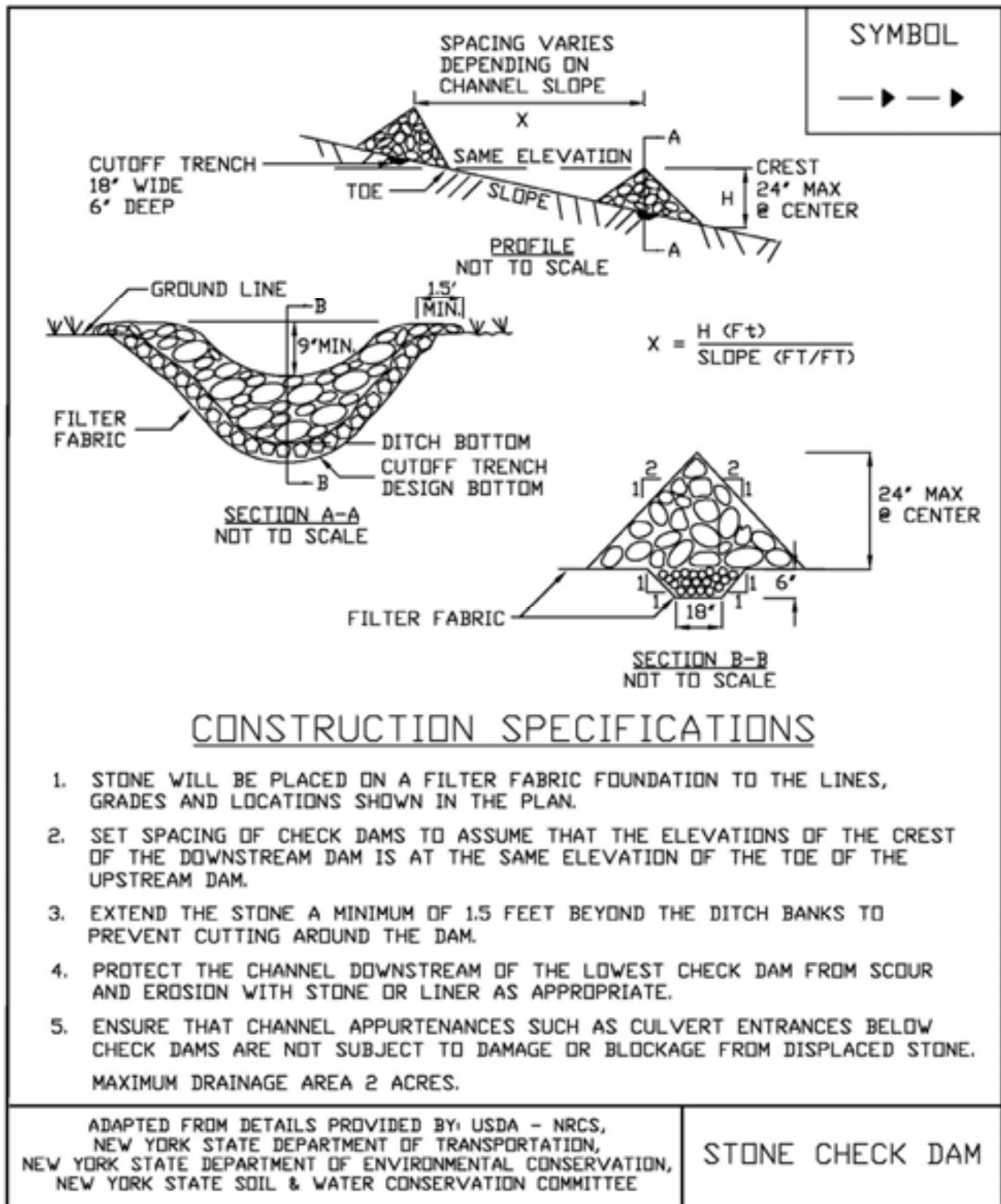
For filter sock or fiber roll check dams: The check dams will be anchored by staking the dam to the earth contact surface. The dam will extend to the top of the bank. The check dam will have a splash apron of NYS DOT #2 crushed stone extending a minimum 3 feet downstream from the dam and 1 foot up the sides of the channel. The compost and materials for a filter sock check dam shall meet the requirements shown in the standard for Compost Filter Sock on page 5.7.

Maintenance

The check dams should be inspected after each runoff event. Correct all damage immediately. If significant erosion has occurred between structures, a liner of stone or other suitable material should be installed in that portion of the channel or additional check dams added.

Remove sediment accumulated behind the dam as needed to allow channel to drain through the stone check dam and prevent large flows from carrying sediment over the dam.

Figure 3.1
Stone Check Dam Detail



STANDARD AND SPECIFICATIONS FOR CONSTRUCTION DITCH



Definition & Scope

A **temporary** excavated drainage way to intercept sediment laden water and divert it to a sediment trapping device or to prevent runoff from entering disturbed areas by intercepting and diverting it to a stabilized outlet.

Conditions Where Practice Applies

Construction ditches are constructed:

1. to divert flows from entering a disturbed area.
2. intermittently across disturbed areas to shorten over-land flow distances.
3. to direct sediment laden water along the base of slopes to a trapping device.
4. to transport offsite flows across disturbed areas such as rights-of-way.

Ditches collecting runoff from disturbed areas shall remain in place until the disturbed areas are permanently stabilized.

Design Criteria

See Figure 3.2 on page 3.6 for details.

General

	Ditch A	Ditch B
Drainage Area	<5 Ac	5-10 Ac
Bottom Width of Flow Channel	4 ft.	6 ft.
Depth of Flow Channel	1 ft.	1 ft.
Side Slopes	2:1 or flatter	2:1 or flatter
Grade	0.5% Min. 10% Max.	0.5% Min. 10% Max.

For drainage areas larger than 10 acres, refer to the Standard and Specification for Grassed Waterways on page 3.23 and 3.24.

Stabilization

Stabilization of the ditch shall be completed within 2 days of installation in accordance with the appropriate standard and specifications for vegetative stabilization or stabilization with mulch as determined by the time of year. The flow channel shall be stabilized as per the following criteria:

The seeding for vegetative stabilization shall be in accordance with the standard on Page 4.78. The seeded area will be mulched in accordance with the standard on Page 4.39.

Type of Treatment	Channel Grade ¹	Flow Channel	
		A (<5 Ac.)	B (5-10 Ac.)
1	0.5-3.0%	Seed & Straw Mulch	Seed & Straw Mulch
2	3.1-5.0%	Seed & Straw Mulch	Seed and cover with RECP ² , Sod, or lined with plastic or 2" stone
3	5.1-8.0%	Seed and cover with RECP ² , Sod, or line with plastic or 2 in. stone	Line with 4-8 in. rip-rap or, geotextile
4	8.1-10%	Line with 4-8 in. rip-rap or geotextile	Site Specific Design

1 In highly erodible soils, as defined by the local approving agency, refer to the next higher slope grade for type of stabilization.
2 Rolled Erosion Control Product.

Outlet

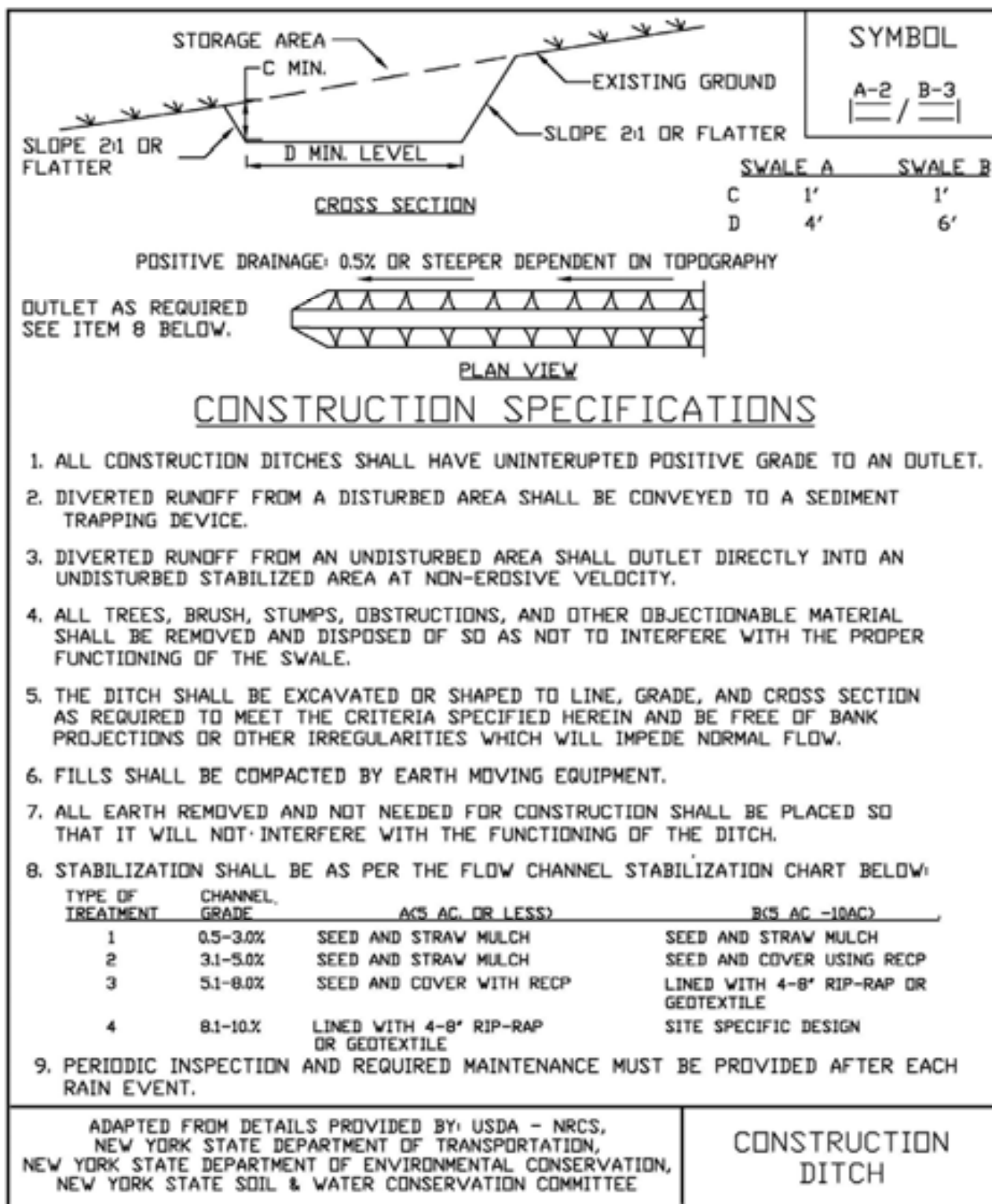
Ditch shall have an outlet that functions with a minimum of erosion, and dissipates runoff velocity prior to discharge off the site.

Runoff shall be conveyed to a sediment trapping device such as a sediment trap or sediment basin until the drainage area above the ditch is adequately stabilized.

The on-site location may need to be adjusted to meet field conditions in order to utilize the most suitable outlet condition.

If a ditch is used to divert clean water flows from entering a disturbed area, a sediment trapping device may not be needed.

**Figure 3.2
Construction Ditch Detail**



STANDARD AND SPECIFICATIONS FOR DEWATERING SUMP PIT



Discharge of turbid water pumped from the standpipe should be to a sediment trap, sediment basin, filter bag or stabilized area, such as a filter strip. If water from the sump pit will be pumped directly to a storm drain system, filter cloth with an equivalent sieve size between 40-80 should be wrapped around the standpipe to ensure clean water discharge. It is recommended that $\frac{1}{4}$ to $\frac{1}{2}$ inch hardware cloth be wrapped around and secured to the standpipe prior to attaching the filter cloth. This will increase the rate of water seepage into the standpipe.

Definition & Scope

A **temporary** pit which is constructed using pipe and stone for pumping excessive water from excavations to a suitable discharge area.

Conditions Where Practice Applies

Sump pits are constructed when water collects during the excavation phase of construction. This practice is particularly useful in urban areas during excavation for building foundations. It may also be necessary during construction activities that encounter high ground water tables in floodplain locations.

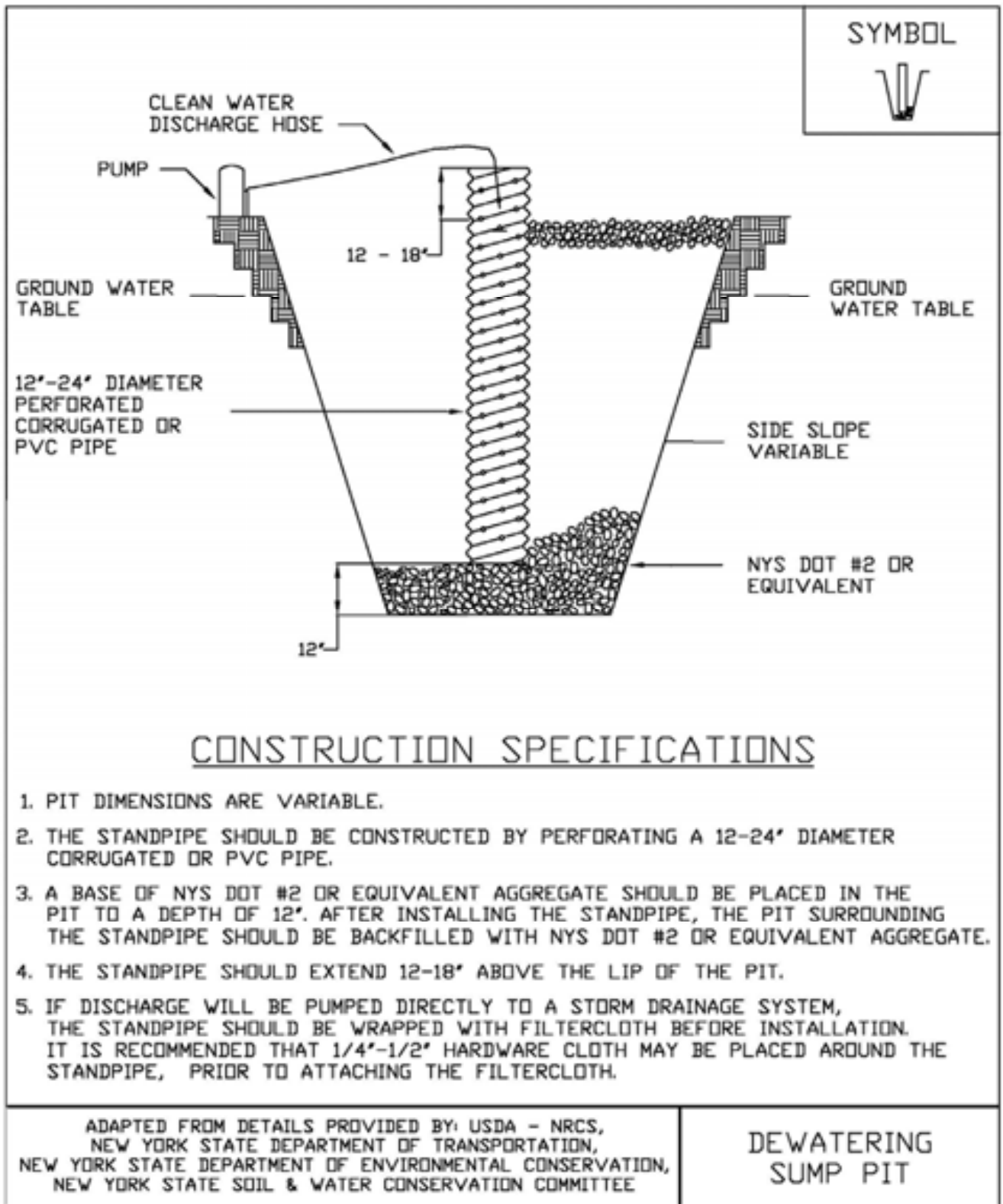
Design Criteria

The number of sump pits and their locations shall be determined by the contractor/engineer. A design is not required, but construction should conform to the general criteria outlined on Figure 3.3 on page 3.8.

A perforated vertical standpipe is placed in the center of the pit and surrounded with a stone screening material to collect filtered water. Water is then pumped from the center of the pipe to a suitable discharge area.



**Figure 3.3
Dewatering Sump Pit Detail**



STANDARD AND SPECIFICATIONS FOR DIVERSION



Definition & Scope

A drainage way of parabolic or trapezoidal cross-section with a supporting ridge on the lower side that is constructed across the slope to intercept and convey runoff to stable outlets at non-erosive velocities.

Conditions Where Practice Applies

Diversions are used where:

1. Runoff from higher areas has potential for damaging properties, causing erosion, or interfering with, or preventing the establishment of, vegetation on lower areas.
2. Surface and/or shallow subsurface flow is damaging sloping upland.
3. The length of slopes needs to be reduced so that soil loss will be kept to a minimum.

Diversions are only applicable below stabilized or protected areas. Avoid establishment on slopes greater than fifteen percent. Diversions should be used with caution on soils subject to slippage. Construction of diversions shall be in compliance with state and local drainage and water laws.

Design Criteria

Location

Diversion location shall be determined by considering outlet conditions, topography, land use, soil type, length of slope, seep planes (when seepage is a problem), and the development layout.

Capacity

Peak rates of runoff values used in determining the capacity requirements shall be calculated using the most current hydrologic data from the Northeast Regional Climate Center in an appropriate model.

The constructed diversion shall have capacity to carry, as a minimum, the peak discharge from a 10 year frequency rainfall event with freeboard of not less than 0.3 feet.

Diversions designed to protect homes, schools, industrial buildings, roads, parking lots, and comparable high-risk areas, and those designed to function in connection with other structures, shall have sufficient capacity to carry peak runoff expected from a storm frequency consistent with the hazard involved.

Cross Section

The diversion channel shall be parabolic or trapezoidal in shape. Parabolic Diversion design charts are provided in Tables 3.2, 3.3 and 3.4 on pages 3.10, 3.12 and 3.13. The diversion shall be designed to have stable side slopes. The side slopes shall not be steeper than 2:1 and shall be flat enough to ensure ease of maintenance of the diversion and its protective vegetative cover.

The ridge shall have a minimum width of four feet at the design water elevation; a minimum of 0.3 feet freeboard and a reasonable settlement factor shall be provided.

Velocity and Grade

The permissible velocity for the specified method of stabilization will determine the maximum grade. Maximum permissible velocities of flow for the stated conditions of stabilization shall be as shown in Table 3.1 on page 3.10 of this standard.

Diversions are not usually applicable below high sediment producing areas unless land treatment practices or structural measures, designed to prevent damaging accumulations of sediment in the channels, are installed with, or before, the diversions.

Outlets

Each diversion must have an adequate outlet. The outlet may be a grassed waterway, vegetated or paved area, grade stabilization structure, flow spreader, flow diffuser, stable watercourse, or subsurface drain outlet. In all cases, the outlet must convey runoff to a point where outflow will not cause damage. Vegetated outlets shall be installed before diversion construction, if needed, to ensure establishment of

vegetative cover in the outlet channel.

Stabilization

The design elevation of the water surface in the diversion shall not be lower than the design elevation of the water surface in the outlet at their junction when both are operating at design flow.

Vegetated diversions shall be stabilized in accordance with the following tables.

**Table 3.1
Diversion Maximum Permissible Design Velocities Table**

Soil Texture	Retardance and Cover	Permissible Velocity (ft / second) for Selected Channel Vegetation
Sand, Silt, Sandy loam, silty loam, loamy sand (ML, SM, SP, SW)	C-Kentucky 31 tall fescue and Kentucky bluegrass	3.0
	D-Annuals ¹ Small grain (rye, oats, barley, millet) Ryegrass	2.5
Silty clay loam, Sandy clay loam (ML-CL, SC)	C-Kentucky 31 tall fescue and Kentucky bluegrass	4.0
	D-Annuals ¹ Small grain (rye, oats, barley, millet) Ryegrass	3.5
Clay (CL)	C-Kentucky 31 tall fescue and Kentucky bluegrass	5.0
	D-Annuals ¹ Small grain (rye, oats, barley, millet) Ryegrass	4.0

¹ Annuals—Use only as temporary protection until permanent vegetation is established.

Table 3.2 - Retardance Factors for Various Grasses and Legumes Table

Retardance	Cover	Condition
A	Reed canarygrass	Excellent stand, tall (average 36 inches)
B	Smooth bromegrass	Good stand, mowed (average 12 to 15 inches)
	Tall fescue	Good stand, unmowed (average 18 inches)
	Grass-legume mixture—Timothy, smooth bromegrass, or Orchard grass with birdsfoot trefoil	Good stand, uncut (average 20 inches)
	Reed canarygrass	Good stand, mowed (average 12 to 15 inches)
	Tall fescue, with birdsfoot trefoil or ladino clover	Good stand, uncut (average 18 inches)
C	Redtop	Good stand, headed (15 to 20 inches)
	Grass-legume mixture—summer (Orchard grass, redtop, Annual ryegrass, and ladino or white clover)	Good stand, uncut (6 to 8 inches)
	Kentucky bluegrass	Good stand, headed (6 to 12 inches)
D	Red fescue	Good stand, headed (12 to 18 inches)
	Grass-legume mixture—fall, spring (Orchard grass, redtop, Annual ryegrass, and white or ladino clover)	Good stand, uncut (4 to 5 inches)

**Figure 3.4
Diversion Detail**

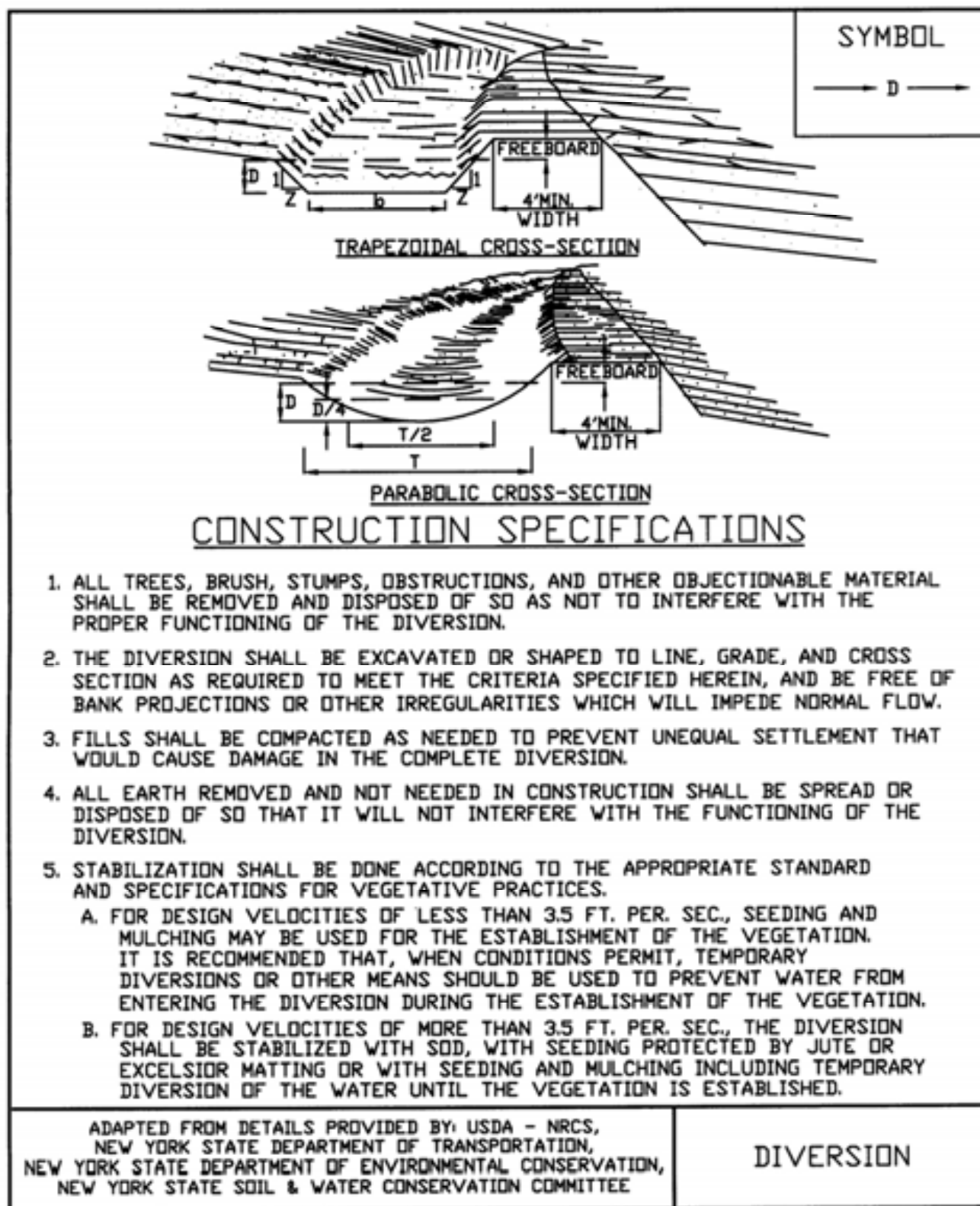


Table 3.4

Parabolic Diversion Design, Without Freeboard Tables - 2 (USDA-NRCS)

PARABOLIC DIVERSION DESIGN, WITHOUT FREEBOARD													RETARDANCE - D & C GRADE, % - 1.5					
V ₁ Based on Permissible Velocity of the Soil With Retardance "D" Top Width, Depth & V ₂ Based on Retardance "C"																		
Q	V ₁ = 2.0		V ₁ = 2.5		V ₁ = 3.0		V ₁ = 3.5		V ₁ = 4.0		V ₁ = 4.5		V ₁ = 5.0		V ₁ = 5.5		V ₁ = 6.0	
cfs	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D
15	17	0.9	1.4	11	1.1	1.9	8	1.2	2.4									
20	23	0.9	1.4	15	1.0	1.9	10	1.2	2.5									
25	28	0.9	1.4	19	1.0	1.9	12	1.2	2.6									
30	34	0.9	1.4	22	1.0	1.9	15	1.2	2.6	10	1.3	3.2	8	1.5	3.6			
35	40	0.9	1.4	26	1.0	2.0	17	1.1	2.6	12	1.3	3.3	10	1.4	3.7	7	1.6	4.0
40	45	0.9	1.4	30	1.0	1.9	20	1.2	2.6	14	1.3	3.3	11	1.4	3.7	9	1.6	4.2
45	51	0.9	1.4	33	1.0	2.0	22	1.1	2.6	15	1.3	3.4	12	1.4	3.8	10	1.5	4.3
50	56	0.9	1.4	37	1.0	2.0	25	1.1	2.7	17	1.3	3.4	14	1.4	3.9	11	1.5	4.3
55	62	0.9	1.5	41	1.0	2.0	27	1.1	2.6	19	1.3	3.4	15	1.4	3.9	12	1.5	4.3
60	67	0.9	1.5	44	1.0	2.0	30	1.1	2.7	21	1.3	3.4	16	1.4	3.9	14	1.7	4.9
65	73	0.9	1.5	48	1.0	2.0	32	1.1	2.7	22	1.3	3.4	18	1.4	3.9	15	1.7	5.0
70	78	0.9	1.5	51	1.0	2.0	34	1.1	2.7	24	1.3	3.4	19	1.4	3.9	16	1.5	4.4
75	83	0.9	1.5	55	1.0	2.0	37	1.1	2.7	25	1.3	3.4	21	1.4	3.9	17	1.5	4.4
80	89	0.9	1.5	59	1.0	2.0	39	1.1	2.7	27	1.3	3.4	22	1.4	3.9	18	1.5	4.4
90	100	0.9	1.5	66	1.0	2.0	44	1.1	2.7	30	1.3	3.5	25	1.4	3.9	20	1.5	4.4
100				73	1.0	2.0	49	1.1	2.7	33	1.3	3.5	27	1.4	3.9	22	1.5	4.5

PARABOLIC DIVERSION DESIGN, WITHOUT FREEBOARD													RETARDANCE - D & C GRADE, % - 2.0					
V ₁ Based on Permissible Velocity of the Soil With Retardance "D" Top Width, Depth & V ₂ Based on Retardance "C"																		
Q	V ₁ = 2.0		V ₁ = 2.5		V ₁ = 3.0		V ₁ = 3.5		V ₁ = 4.0		V ₁ = 4.5		V ₁ = 5.0		V ₁ = 5.5		V ₁ = 6.0	
cfs	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D
15	21	0.8	1.3	13	0.9	1.9	9	1.0	2.4	7	1.2	2.9						
20	28	0.8	1.3	17	0.9	1.9	12	1.0	2.4	9	1.1	3.0						
25	35	0.8	1.3	21	0.9	1.9	15	1.0	2.4	11	1.1	3.0						
30	41	0.8	1.3	26	0.9	1.9	18	1.0	2.5	13	1.1	3.0	10	1.2	3.7	8	1.3	4.0
35	48	0.8	1.4	30	0.9	1.9	22	1.0	2.4	15	1.1	3.1	11	1.2	3.8	9	1.3	4.2
40	55	0.8	1.3	34	0.9	1.9	25	1.0	2.5	16	1.1	3.1	13	1.2	3.8	11	1.3	4.3
45	62	0.8	1.4	38	0.9	1.9	28	1.0	2.5	20	1.1	3.1	14	1.2	3.8	12	1.3	4.3
50	68	0.8	1.4	42	0.9	1.9	31	1.0	2.5	22	1.1	3.1	16	1.2	3.9	13	1.3	4.3
55	75	0.8	1.4	46	0.9	1.9	34	1.0	2.5	24	1.1	3.1	17	1.2	3.8	14	1.3	4.3
60	82	0.8	1.4	51	0.9	1.9	37	1.0	2.5	26	1.1	3.1	19	1.2	3.9	16	1.3	4.4
65	88	0.8	1.4	55	0.9	1.9	40	1.0	2.5	28	1.1	3.1	21	1.2	3.9	17	1.3	4.4
70	95	0.8	1.4	59	0.9	1.9	43	1.0	2.5	30	1.1	3.1	22	1.2	3.9	18	1.3	4.4
75				63	0.9	1.9	46	1.0	2.5	32	1.1	3.2	24	1.2	3.9	20	1.3	4.4
80				67	0.9	2.0	48	1.0	2.5	35	1.1	3.2	25	1.2	3.9	21	1.3	4.4
90				75	0.9	2.0	54	1.0	2.5	39	1.1	3.2	28	1.2	3.9	23	1.3	4.4
100				83	0.9	2.0	60	1.0	2.5	43	1.1	3.2	31	1.2	3.9	26	1.3	4.4

STANDARD AND SPECIFICATIONS FOR EARTH DIKE



Definition & Scope

A **temporary** berm or ridge of compacted soil, located in such a manner as to channel water to a desired location. Its purpose is to direct runoff to a sediment trapping device, thereby reducing the potential for erosion and off site sedimentation. Earth dikes can also be used for diverting clean water away from disturbed areas.

Conditions Where Practice Applies

Earth dikes are often constructed across disturbed areas and around construction sites such as graded parking lots and subdivisions. The dikes shall remain in place until the disturbed areas are permanently stabilized.

Design Criteria

See Figure 3.5 on page 3.15 for details.

General

	Dike A	Dike B
Drainage Area	<5 Ac	5-10 Ac
Dike Height	18 in.	36 in.
Dike Width	24 in.	36 in.
Flow Width	4 ft.	6 ft.
Flow Depth in Channel	8 in.	15 in.
Side Slopes	2:1 or flatter	2:1 or flatter
Grade	0.5% Min. 10% Max.	0.5% Min. 10% Max.

For drainage areas larger than 10 acres, refer to the Standard and Specifications for Diversion on page 3.9.

Stabilization

Stabilization of the dike shall be completed within 2 days of installation in accordance with the standard and specifications for seed and straw mulch or straw mulch only if not in seeding season. The flow channel shall be stabilized as per the following criteria:

Type of Treatment	Channel Grade¹	Flow Channel	
		A (<5 Ac.)	B (5-10 Ac.)
1	0.5-3.0%	Seed & Straw Mulch	Seed & Straw Mulch
2	3.1-5.0%	Seed & Straw Mulch	Seed and cover with RECP, sod, or lined with plastic or 2" stone
3	5.1-8.0%	Seed and cover with RECP, Sod, or line with plastic or 2 in. stone	Line with 4-8 in. rip-rap or, geotextile
4	8.1-10%	Line with 4-8 in. rip-rap or geotextile	Site Specific Design

¹ In highly erodible soils, as defined by the local approving agency, refer to the next higher slope grade for type of stabilization.

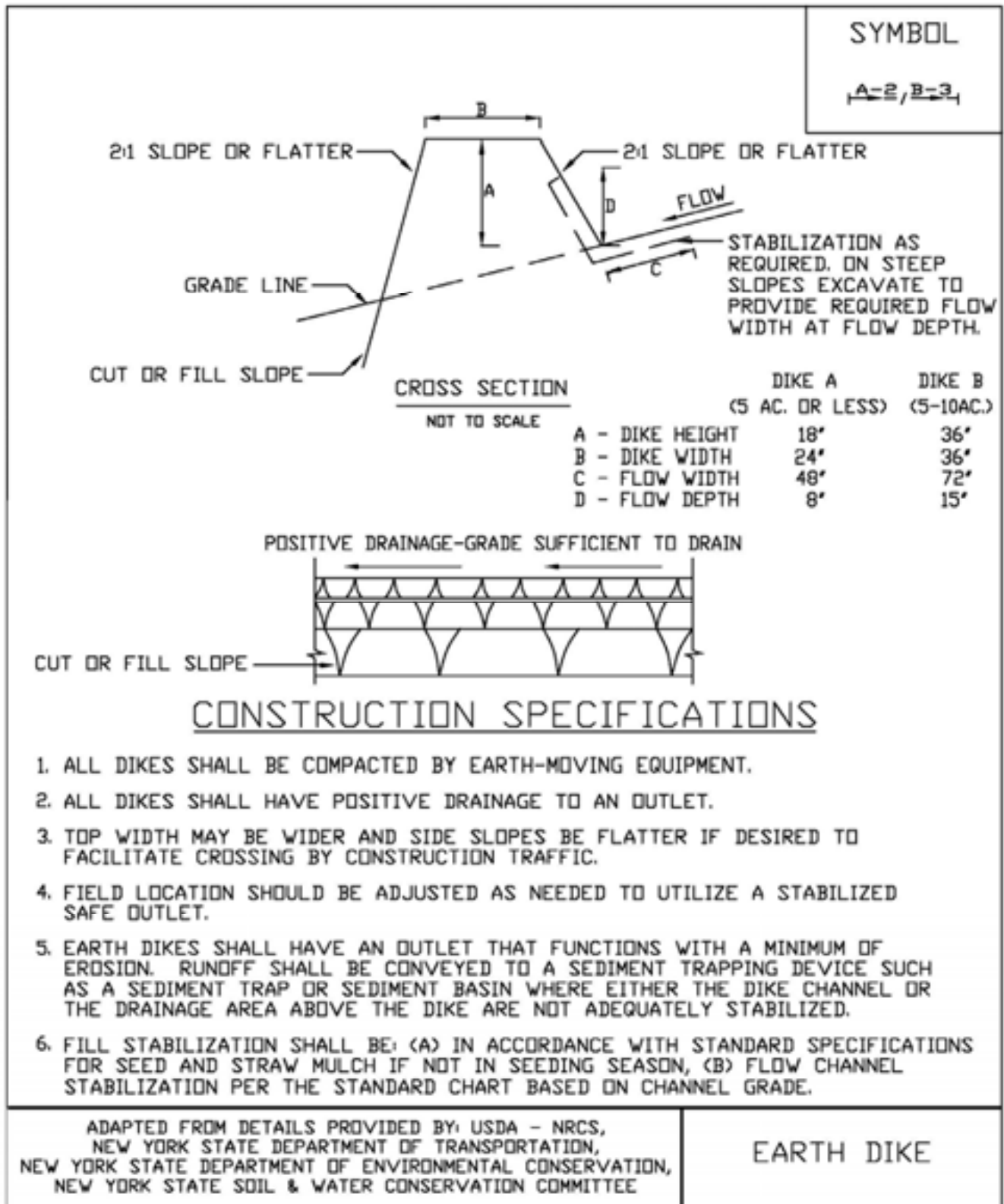
Outlet

Earth dikes shall have an outlet that functions with a minimum of erosion.

Runoff shall be conveyed to a sediment trapping device until the drainage area above the dike is adequately stabilized.

The on-site location may need to be adjusted to meet field conditions in order to utilize the most suitable outlet.

**Figure 3.5
Earth Dike Detail**



STANDARD AND SPECIFICATIONS FOR FLOW DIFFUSER



Definition & Scope

A permanent non-erosive outlet for concentrated runoff constructed to diffuse flow uniformly through a stone matrix onto a stabilized area in the form of shallow, low velocity, sheet flow.

Conditions Where Practice Applies

Where sediment-free stormwater runoff can be released in low velocity sheet flow down stabilized areas without causing erosion; where the ground slope at the outlet of the diffuser is less than 30% and the runoff will not re-concentrate after release; and where construction of a flow spreader is not practicable.

Design Criteria

1. **Drainage area:** The maximum drainage area to the diffuser may not exceed 0.10 acre per foot length of the flow diffuser. The drainage area served by the diffuser discharging directly cannot be 10-20% more than half the size of the receiving buffer area.
2. **Discharge from diffuser onto receiving area:** The peak stormwater flow rate from a flow diffuser onto a receiving area from a 10-year 24-hour storm must be less than 0.25 cubic feet per second (0.25 cfs) per linear foot of weir crest length.
3. **Receiving area of buffer:** Each flow diffuser shall have a vegetated receiving area with a minimum continuous length of 150 feet and the capacity to pass the flow without erosion. The receiving area shall be stable prior to the construction of the flow diffuser. The receiving area shall have topography regular enough to

prevent undue flow concentration before entering a stable watercourse but it shall have a slope that is less than 30%. If the receiving area is not presently stable, then the receiving area shall be stabilized prior to construction of the flow diffuser. The receiving area below the flow diffuser shall be protected from harm during construction. Sodding and/or turf reinforcement mat (TRM) in combination with vegetative measures shall stabilize disturbed areas. The receiving area shall not be used by the flow diffuser until stabilization has been accomplished. A temporary diversion may be necessary in this case.

4. **Cross-section:** The minimum stone diffuser cross-section shall be trapezoidal with a height of 1 foot above natural ground; top width equal to 2 foot and side slope equal to 1 horizontal to 1 vertical. The storage area behind the diffuser shall be excavated to a depth of 1 foot and overall width of storage area equal to 6 feet minimum.
5. **Sizing the diffuser:** The length of the stone diffuser is governed by the size of the stone in the structure, the height of the diffuser, and the flow length through it. The following equation is used to establish the design of the diffuser:

$$Q_d = \frac{h^{3/2} W}{\left[\left(\frac{L}{D}\right) + 2.5 + L^2\right]^{0.5}}$$

Where:

Q_d = Outflow through the stone diffuser (cfs)

h = Ponding depth behind the diffuser (ft.)

W = Linear length of the diffuser along centerline (ft.)

L = Average horizontal flow length through the diffuser perpendicular to the centerline (ft.)

D = Average stone diameter (d_{50}) in the structure (ft.)

The maximum d_{50} size shall be 9" or 0.75'.

The designer shall calculate the length of diffuser needed depending on the geometry of the cross-section and rock size to be used recognizing that the maximum allowable discharge through the diffuser shall be 0.25 cfs per foot of length.

Once the discharge is calculated for the 10 year storm for the drainage area to the diffuser (Q_{10}) it can be divided by the design discharge of the diffuser to determine the diffuser length as follows:

$$W = \frac{Q_{10}}{Q_d}$$

Where:

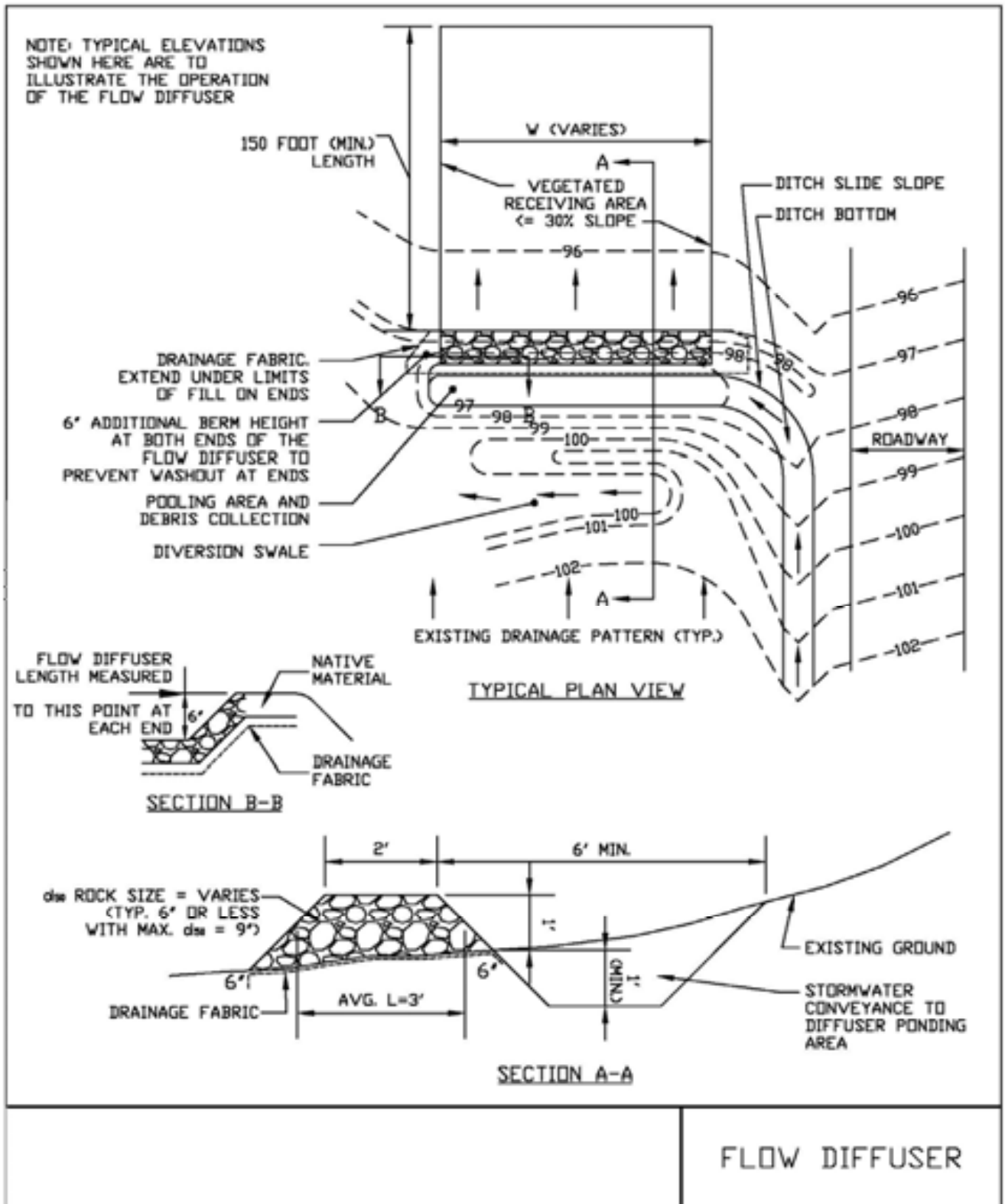
Q_d = Outflow through the stone diffuser (cfs/ft)

Q_{10} = Discharge rate for the 10 year storm (cfs)

W = Linear length of the diffuser along centerline (ft.)

Design examples are shown in Appendix B.

Figure 3.6
Flow Diffuser Detail



STANDARD AND SPECIFICATIONS FOR FLOW SPREADER



Definition & Scope

A **permanent or temporary**, non-erosive outlet for concentrated runoff, constructed to disperse concentrated flow uniformly over a hardened weir into a stabilized area as shallow, low velocity, sheet flow.

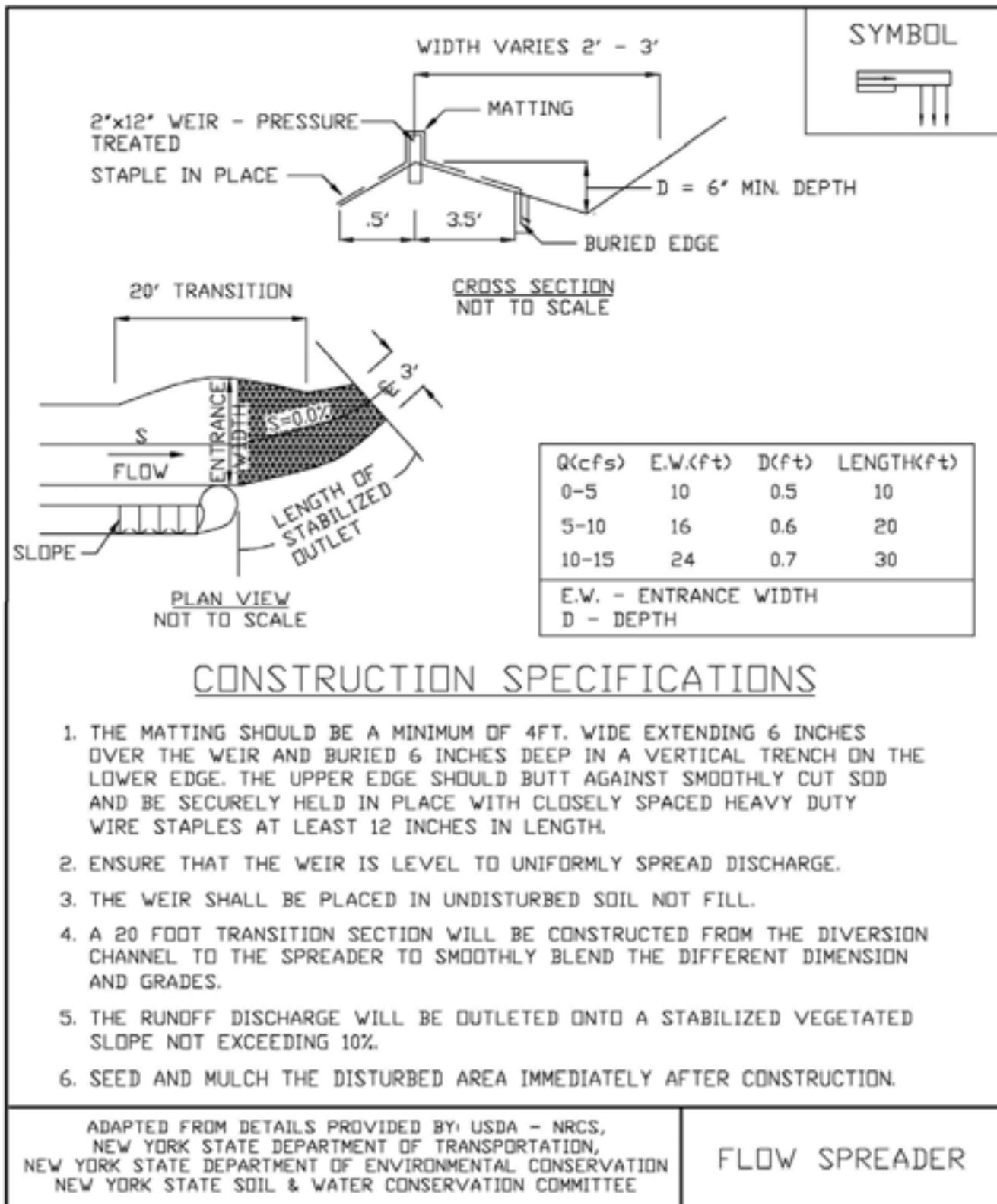
Conditions Where Practice Applies

Where sediment-free storm runoff can be released in sheet flow down a stabilized slope without causing erosion; where a hardened level weir can be constructed without filling; where the area below the weir is uniform with a slope of 10% or less and the runoff will not re-concentrate after release; and where no traffic will disturb the flow spreader.

Design Criteria

1. **Drainage area:** The maximum drainage area to the spreader may not exceed 5 acres.
2. **Discharge to a flow spreader:** The peak stormwater flow rate to a flow spreader due to runoff from a 10-year 24-hour storm must be less than 0.5 cubic feet per second (0.5 cfs) per foot length of flow spreader lip.
3. **Length of flow spreader:** The flow spreader length may not be more than 30 feet if flow is entering from one end of the spreader. Longer lengths require flow to split evenly from the center of the spreader.
4. **Receiving area of buffer:** Each flow spreader shall have a vegetated receiving area with the capacity to pass the flow without erosion. The receiving area shall be stable prior to the construction of the flow spreader. The receiving area shall have topography regular enough to prevent undue flow concentration before entering a stable watercourse but it shall have a slope that is less than 10%. If the receiving area is not presently stable, then the receiving area shall be stabilized prior to construction of the flow spreader. The receiving area below the flow spreader shall be protected from harm during construction. Sodding and/or turf reinforced mat in combination with vegetative measures shall stabilize disturbed areas. The receiving area shall not be used by the flow spreader until stabilization has been accomplished. A temporary diversion may be necessary in this case.
5. **Weir:** The weir of the flow spreader should consist of a pressure treated 2"x12" timber plank laid on edge and set at level elevation perpendicular to flow. Alternate hardened weir structures may be used as long as a hard, durable, continuous weir is maintained.
6. **Channel:** The flow spreader entrance channel shall be a minimum of 1 foot deep with a minimum 2 foot bottom width to trap sediment and reduce lateral flow velocities. Side slopes shall be 2:1 or flatter. The channel shall be constructed with a 0% grade to ensure uniform flow distribution. Velocity entering the channel shall be reduced to ensure non-erosive low approach velocity in the weir.
7. **Maintenance:** Long term maintenance of the flow spreader is essential to ensure its continued effectiveness. The following provisions should be followed. In the first year the flow spreader should be inspected semi annually and following major storm events for any signs of channelization and should be immediately repaired. After the first year, annual inspection should be sufficient. Spreaders constructed of wood, asphalt, stone or concrete curbing require periodic inspection to check for damage and to be repaired as needed.
 - A. **Inspections:** At least once a year, the spreader pool should be inspected for sand accumulation and debris that may reduce capacity.
 - B. **Maintenance Access:** Flow spreaders should be sited to provide easy access for removal of accumulated sediment and rehabilitation of the berm.
 - C. **Debris Removal:** Debris buildup within the channel should be removed when it has accumulated to approximately 10 to 20% of design volume or channel capacity. Remove debris such as leaf litter, branches, tree growth and any sediment build-up from the spreader and dispose of appropriately.
 - D. **Mowing:** Vegetated spreaders may require mowing.

Figure 3.7
Flow Spreader Detail



STANDARD AND SPECIFICATIONS FOR GRADE STABILIZATION STRUCTURE



Definition & Scope

A **permanent** structure to stabilize the grade or to control head cutting in artificial channels by reduction of velocities and grade in the watercourse or by providing channel linings or structures that can withstand the higher velocities.

Conditions Where Practice Applies

This practice applies to sites where the capability of earth and vegetative measures is exceeded in the safe handling of water at permissible velocities, where excessive grades or overfall conditions are encountered, or where water is to be lowered structurally from one elevation to another. These structures should generally be planned and installed along with, or as a part of, other practices in an overall surface water management system.

Design Criteria

Compliance with Laws and Regulations

Design and construction shall be in compliance with state and local laws and regulations. Such compliance is the responsibility of the landowner or developer.

General

Designs and specifications shall be prepared for each structure on an individual job basis depending on its purpose, site conditions, and the basic criteria of the conservation practice with which the structure is planned. Typical structures are as follows:

1. Channel linings of concrete, asphalt, half round metal pipe or other suitable lining materials. These linings should generally be used where channel velocities ex-

ceed safe velocities for vegetated channels due to increased grade or a change in channel cross section or where durability of vegetative lining is adversely affected by seasonal changes. Adequate protection will be provided to prevent erosion or scour of both ends of the channel lining.

2. Overfall structures of concrete, metal, rock riprap, or other suitable material is used to lower water from one elevation to another. These structures are applicable where it is desirable to drop the watercourse elevation over a very short horizontal distance. Adequate protection will be provided to prevent erosion or scour upstream, downstream and along sides of overfall structures. Structures should be located on straight sections of channel with a minimum of 100 feet of straight channel each way.
3. Pipe drops of metal pipe with suitable inlet and outlet structures. The inlet structure may consist of a vertical section of pipe or similar material, an embankment, or a combination of both. The outlet structure will provide adequate protection against erosion or scour at the pipe outlet.

Capacity

Structures that are designed to operate in conjunction with other erosion control practices shall have, as a minimum, capacity equal to the bankfull capacity of the channel delivering water to the structures. The minimum design capacity for structures that are not designed to perform in conjunction with other practices shall be that required to handle the peak rate of flow from a 10-year, 24-hour frequency storm or bankfull, whichever is greater. Peak rates of runoff used in determining the capacity requirements shall be determined by appropriate methods.

Set the rest of the structure at an elevation that will stabilize the grade of the upstream channel. The outlet should be set at an elevation to assure stability. Outlet velocities should be kept within the allowable limits for the receiving stream. Structural drop spillways need to include a foundation drainage system to reduce hydrostatic loads.

Permanent structures which involve the retarding of floodwater or the impoundment of water shall be designed using the criteria set forth in the New York State DEC Guidelines for the Design of Dams.

Construction Specifications

Structures shall be installed according to lines and grades shown on the plan. The foundation for structures shall be cleared of all undesirable materials prior to the installation of the structure. Materials used in construction shall be in conformance with the design frequency and life expectancy of the practice. Earth fill, when used as a part of the structure, shall be placed in 4-inch lifts and hand compacted within 2 feet of the structure.

Seeding, fertilizing, and mulching shall conform to the applicable standards and specifications in Section 4.

Construction operations shall be carried out in such a manner that erosion and air and water pollution will be minimized. State and local laws concerning pollution abatement shall be complied with at every site.

Locate emergency bypass areas so that floods in excess of structural capacity enter the channel far enough downstream so as not to cause damage to the structure.

Maintenance

Once properly installed, the maintenance for the grade stabilization structure should be minimal. Inspect the structure periodically and after major storm events. Check fill for piping or extreme settlement. Ensure a good vegetative cover. Check the channel for scour or debris and loss of rock from aprons. Repair or replace failing structures immediately.

STANDARD AND SPECIFICATIONS FOR GRASSED WATERWAY



Definition & Scope

A natural or **permanent** man-made channel of parabolic or trapezoidal cross-section that is below adjacent ground level and is stabilized by suitable vegetation. The flow channel is normally wide and shallow and conveys the runoff down the slope without causing damage by erosion.

Conditions Where Practice Applies

Grass waterways are used where added vegetative protection is needed to control erosion resulting from concentrated runoff.

Design Criteria

Capacity

The minimum capacity shall be that required to confine the peak rate of runoff expected from a 10-year 24 hour frequency rainfall event or a higher frequency corresponding to the hazard involved. This requirement for confinement may be waived on slopes of less than one (1) percent where out-of-bank flow will not cause erosion or property damage.

Peak rates of runoff values used in determining the capacity requirements shall be computed by appropriate methods. Where there is base flow, it shall be handled by a stone center, subsurface drain, or other suitable means since sustained wetness usually prevents adequate vegetative cover. The cross-sectional area of the stone center or subsurface drain size to be provided shall be determined by using a flow rate of 0.1 cfs/acre or by actual measurement of the maximum base flow.

Velocity

Please see Table 3.1, Diversion Maximum Permissible Design Velocities on page 3.10, for seed, soil, and velocity variables.

Cross Section

The design water surface elevation of a grassed waterway receiving water from diversions or other tributary channels shall be equal to or less than the design water surface elevation in the diversion or other tributary channels.

The top width of parabolic waterways shall not exceed 30 feet and the bottom width of trapezoidal waterways shall not exceed 15 feet unless multiple or divided waterways, stone center, or other means are provided to control meandering of low flows.

Structural Measures

In cases where grade or erosion problems exist, special control measures may be needed such as lined waterways (see page 3.27), or grade stabilization measures (see page 3.21). Where needed, these measures will be supported by adequate design computations. For typical cross sections of waterways with riprap sections or stone centers, refer to Figure 3.8 on page 3.24.

The design procedures for parabolic and trapezoidal channels are available in the NRCS Engineering Field Handbook. Figure 3.9 on page 3.25 also provides a design chart for parabolic waterway.

Outlets

Each waterway shall have a stable outlet. The outlet may be another waterway, a stabilized open channel, grade stabilization structure, etc. In all cases, the outlet must discharge in such a manner as not to cause erosion. Outlets shall be constructed and stabilized prior to the operation of the waterway.

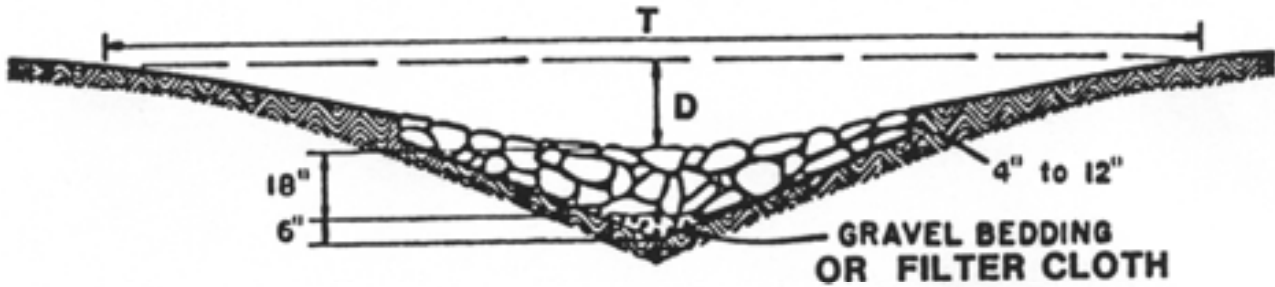
Stabilization

Waterways shall be stabilized in accordance with the appropriate vegetative stabilization standard and specifications, and will be dependent on such factors as slope, soil class, etc. See standard for Vegetating Waterways on Page 4.78.

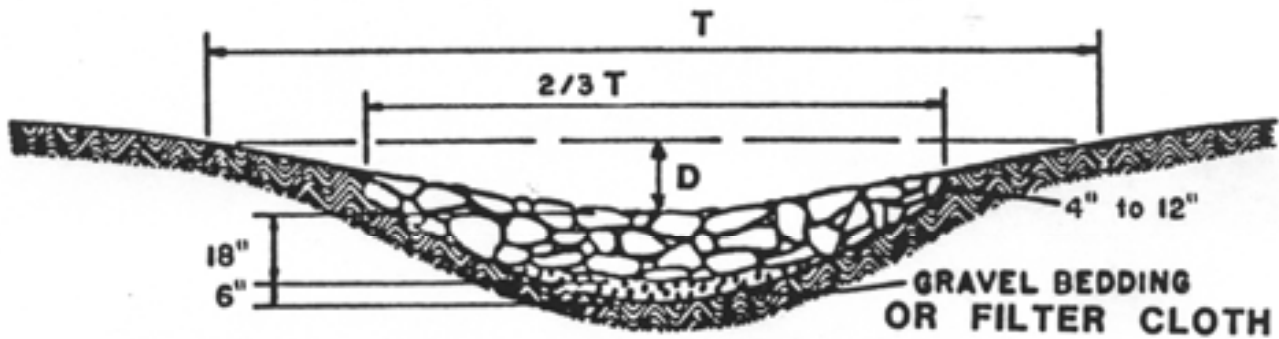
Construction Specifications

See Figure 3.10 on page 3.26 for details.

Figure 3.8
Typical Waterway Cross Sections Details

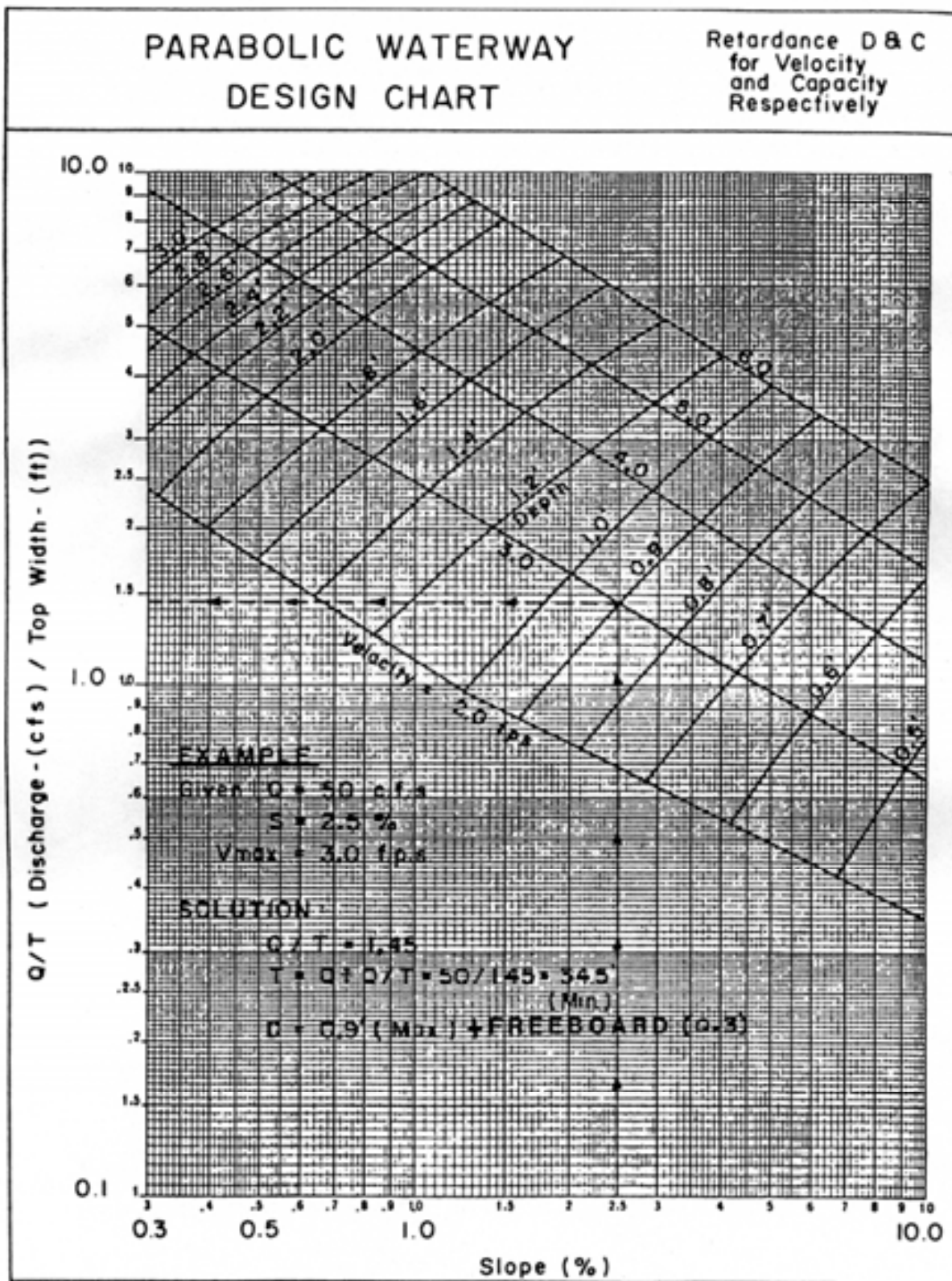


Waterway with stone center drain. "V" section shaped by motor grader.

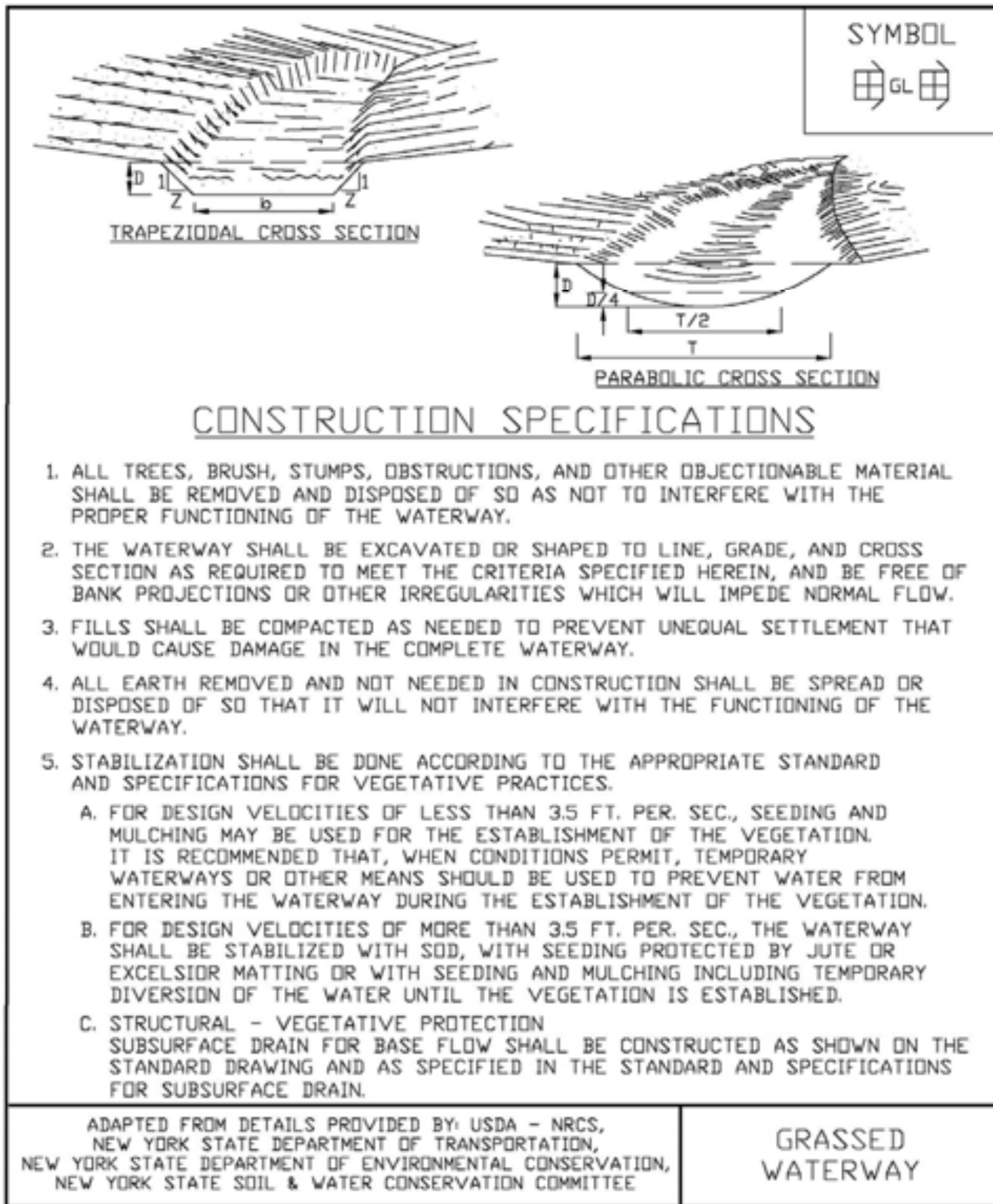


Waterway with stone center drain. Rounded section shaped by bulldozer.

Figure 3.9
Parabolic Waterway Design Chart (USDA - NRCS)



**Figure 3.10
Grassed Waterway Detail**



STANDARD AND SPECIFICATIONS FOR LINED WATERWAY



lets.

4. Soils are highly erosive or other soil and climate conditions preclude using vegetation.
5. High value property or adjacent facilities warrant the extra cost to contain design runoff in a limited space.

Design Criteria

Capacity

1. The minimum capacity shall be adequate to carry the peak rate of runoff from a 10-year, 24-hour storm. Velocity shall be computed using Manning's equation with a coefficient of roughness "n" as follows:

Lined Material	"n"
Concrete (Type):	
Trowel Finish	0.015
Float Finish	0.019
Gunite	0.019
Flagstone	0.022
Riprap	Determine from Figure 3.11 on page 3.30
Gabion	0.030

Definition & Scope

A **permanent** waterway or outlet with a lining of concrete, stone, or other durable, hardened material. The lined section extends up the side slopes to the designed depth. The earth above the permanent lining may be vegetated or otherwise protected.

The lined waterway is constructed to provide for the disposal of concentrated runoff without damage from erosion or flooding, where grassed waterways would be inadequate due to high velocities.

Conditions Where Practice Applies

This standard applies to waterways or outlets with linings of cast-in-place concrete, flagstone mortared in place, rock riprap, gabions, or similar permanent linings. It does not apply to irrigation ditch or canal linings, grassed waterways with stone centers or small lined sections that carry prolonged low flows, or to reinforced concrete channels. Lined waterways should not be used if they are directly discharging to C(T) or higher streams unless thermal impacts are mitigated by biotechnical practices (Section 4). The maximum capacity of the waterway flowing at design depth shall not exceed 100 cubic feet per second.

This practice applies where the following or similar conditions exist:

1. Concentrated runoff is such that a lining is required to control erosion.
2. Steep grades, wetness, prolonged base flow, seepage, or piping that would cause erosion.
3. The location is such that damage from use by people or animals precludes use of vegetated waterways or out-

2. Riprap gradation and filter (bedding) are generally designed in accordance with criteria set forth in the National Cooperative Highway Research Program Report 108, available from the University Microfilm International, 300 N. Zeeb Road, Ann Arbor, Michigan 48106, Publication No. PB-00839; or the Hydraulic Engineering Circular No. 11, prepared by the U.S. Bureau of Public Roads, available from Federal Highway Administration, 400 7th Street, S.W., Washington, D.C. 20590, HNG-31, or the procedure in the USDA-NRCS's Engineering Field Manual, Chapter 16.

Velocity

1. Maximum design velocity shall be as shown below. Except for short transition sections, flow with a channel gradient within the range of 0.7 to 1.3 of this flow's critical slope must be avoided unless the channel is straight. Velocities exceeding critical will be restricted to straight reaches.

Design Flow Depth (ft.)	Maximum Velocity (ft./sec.)
0.0 - 0.5	25
0.5 - 1.0	15
Greater than 1.0	10

- Waterways or outlets with velocities exceeding critical shall discharge into an energy dissipater to reduce velocity to less than critical, or to a velocity the downstream soil and vegetative conditions will allow.

Cross Section

The cross section shall be triangular, parabolic, or trapezoidal. Monolithic concrete or gabions may be rectangular.

Freeboard

The minimum freeboard for lined waterways or outlets shall be 0.25 feet above design high water in areas where erosion resistant vegetation cannot be grown adjacent to the paved side slopes. No freeboard is required where good vegetation can be grown and is maintained.

Side Slope

Steepest permissible side slopes, horizontal to vertical will be as follows:

- Non-Reinforced Concrete
 - Hand-placed, formed concrete
 - Height of lining, 1.5 ft or less Vertical
 - Hand placed screened concrete or mortared
 - In-place flagstone
 - Height of lining, less than 2 ft 1 to 1
 - Height of lining, more than 2 ft 2 to 1
- Slip form concrete:
 - Height of lining, less than 3 ft 1 to 1
- Rock Riprap 2 to 1
- Gabions Vertical
- Pre-cast Concrete Sections Vertical

Lining Thickness

Minimum lining thickness shall be as follows:

- Concrete 4 in. (In most problem areas, shall be 5 in. with welded wire fabric reinforcing)
- Rock Riprap 1.5 x maximum stone size plus thickness of filter or bedding.
- Flagstone 4 in. including mortar bed.

Related Structures

Side inlets, drop structures, and energy dissipaters shall meet the hydraulic and structural requirements of the site.

Filters or Bedding

Filters or bedding to prevent piping, reduce uplift pressure, and collect water will be used as required and will be designed in accordance with sound engineering principles. Weep holes and drains should be provided as needed.

Concrete

Concrete used for lining shall be so proportioned that it is plastic enough for thorough consolidation and stiff enough to stay in place on side slopes. A dense product will be required. A mix that can be certified as suitable to produce a minimum strength of at least 3,000 pounds per square inch will be required. Cement used shall be Portland Cement, Type I, II, IV, or V. Aggregate used shall have a maximum diameter of 1 ½ inches.

Weep holes should be provided in concrete footings and retaining walls to allow free drainage of water. Pipe used for weep holes shall be non-corrosive.

Mortar

Mortar used for mortared in-place flagstone shall consist of a mix of cement, sand, and water. Follow directions on the bag of mortar for proper mixing of mortar and water.

Contraction Joints

Contraction joints in concrete linings, where required, shall be formed transversely to a depth of about one third the thickness of the lining at a uniform spacing in the range of 10 to 15 feet.

Rock Riprap or Flagstone

Stone used for riprap or gabions shall be dense and hard enough to withstand exposure to air, water, freezing, and thawing. Flagstone shall be flat for ease of placement and have the strength to resist exposure and breaking. Rock riprap maximum size shall be as follows:

Velocity (f.p.s.)	d _{max} (in.)
5.0	6
8.5	12
10	18
12	24
15	36

A complete listing riprap gradations is provided in Table 4.1, page 4.9.

Cutoff Walls

Cutoff walls shall be used at the beginning and ending of concrete lining. For rock riprap lining, cutoff walls shall be keyed into the channel bottom and at both ends of the lining.

Construction Specifications

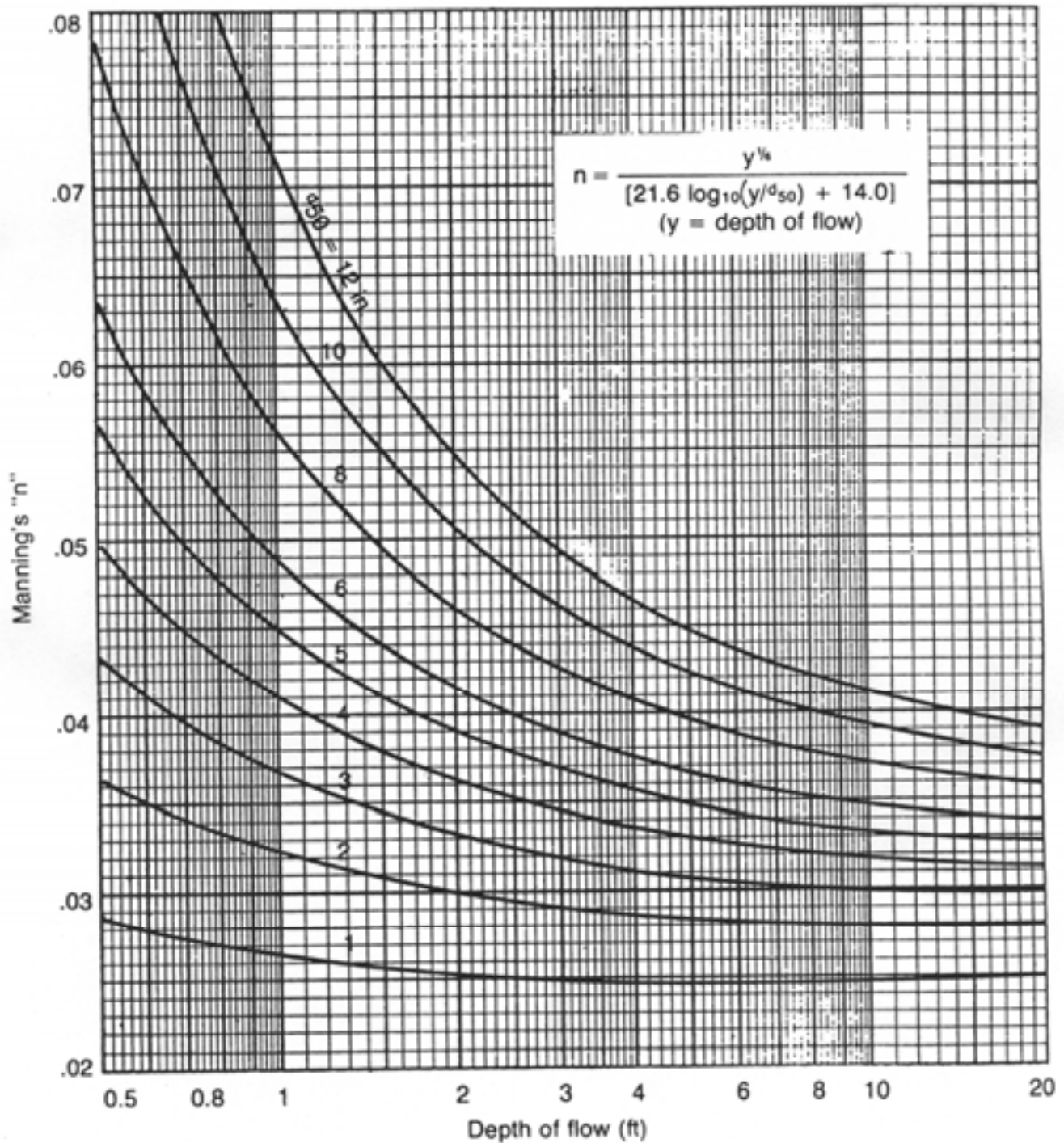
1. The foundation area shall be cleared of trees, stumps, roots, sod, loose rock, or other objectionable material.
2. The cross-section shall be excavated to the neat lines and grades as shown on the plans. Over-excavated areas shall be backfilled with moist soil compacted to the density of the surrounding material.
3. No abrupt deviations from design grade or horizontal alignment shall be permitted.
4. Concrete linings shall be placed to the thickness shown on the plans and trowel finished. Adequate precautions shall be taken to protect freshly placed concrete from extreme (hot or cold) temperatures, to ensure proper curing.
5. Filter bedding and rock riprap shall be placed to line and grade in the manner specified.
6. Construction operation shall be done in such a manner that erosion, air pollution, and water pollution will be minimized and held within legal limits. The completed job shall meet all design requirements for the appropriate finish. All disturbed areas shall be vegetated or otherwise protected against soil erosion.

Maintenance

Pavement or lining should be maintained as built to prevent undermining and deterioration. Existing trees next to pavements should be removed, as roots can cause uplift damage.

Vegetation next to pavement should be maintained in good condition to prevent scouring if the pavement is overtopped. See Standard and Specifications for Permanent Construction Area Planting on page 4.42.

Figure 3.11
Determining “n” for Riprap Lined Channel using Depth of Flow Chart
 (USDA - NRCS)



STANDARD AND SPECIFICATIONS FOR PAVED FLUME



Definition & Scope

A **permanent** small concrete-lined channel to convey water from a higher to a lower elevation in a short distance such as down the face of a cut or fill slope without causing erosion. Due to potential thermal impacts and the creation of fish migration barriers, paved flumes shall not be used for direct discharges to C(T) or higher streams.

Condition Where Practice Applies

Where concentrated storm runoff must be conveyed down a cut or fill slope as part of a permanent erosion control system. Paved flumes serve as stable outlets for diversions, drainage channels, or natural drainageways, that are located above relatively steep slopes. Paved flumes should be used on slopes of 1.5 to 1 or flatter.

Design Criteria

Capacity – Minimum capacity should be the 10-year frequency storm. Freeboard or enough bypass capacity should be provided to safeguard the structure from peak flows expected for the life of the structure.

Slope – The slope should not be steeper than 1.5:1 (67%).

Cutoff Walls – Install cutoff walls at the beginning and end of paved flumes. The cutoff should extend a minimum of 18 inches into the soil and across the full width of the flume and be 6 inches thick. Cutoff walls should be reinforced with #3 reinforcing bars (3/8") placed on a 6-inch grid in the center of the wall.

Anchor Lugs – Space anchor lugs a minimum of 10 feet on centers for the length of the flume. They will extend the width of the flume, extend 1 foot into subsoil, be a minimum of 6 inches thick, and be reinforced with #3 reinforcing

ing bars placed on a 6-inch grid.

Concrete – Minimum strength of design mix shall be 3000 psi. Concrete thickness shall be a minimum of 6 inches reinforced with #3 reinforcing bars. Mix shall be dense, durable, stiff enough to stay in place on steep slopes, and sufficiently plastic for consolidation. Concrete mix should include an air-entraining admixture to resist freeze-thaw cycles.

Cross Section – Flumes shall have minimum depth of 1 foot with 1.5:1 side slopes. Bottom widths shall be based on maximum flow capacity. Chutes will be maintained in a straight alignment because of supercritical flow velocities.

Drainage filters – Use a drainage filter with all paved flumes to prevent piping and reduce uplift pressures. Size of the filter material will be dependent on the soil material the flume is located in.

Inlet Section – Design the inlet to the following minimum dimensions: side walls 2 feet high, length 6 feet, width equal to the flume channel bottom, and side slopes the same as the flume channel side slopes.

Outlet Section – Outlets must be protected from erosion. Usually an energy dissipater is used to reduce the high chute velocities to lower non-erosive velocities. Rock riprap should be placed at the end of the dissipater to spread flow evenly to the receiving channel.

See Figure 3.12 on page 3.33 for examples of outlet structures.

Invert – Precast concrete sections may be used in lieu of cast in place concrete. The sections should be designed at the joint to be overlapped to prevent displacement between sections. Joint sealing compound should be used to prevent migration of soil through a joint. Cutoff walls and anchor lugs should be cast in the appropriate sections to accommodate the design criteria.

Small Flumes – Where the drainage area is 10 acres or less, the design dimensions for concrete flumes may be selected from those shown in the table on the following page:

	Drainage Area (Acres)	
	<u>5</u>	<u>10</u>
Min. Bottom Width (ft.)	4	8
Min. Inlet Depth (ft.)	2	2
Min. Channel Depth (ft.)	1.3	1.3
Max. Channel Slope	1.5:1	1.5:1
Max. Side Slope	1.5:1	1.5:1

See Figure 3.13 on page 3.34 for details.

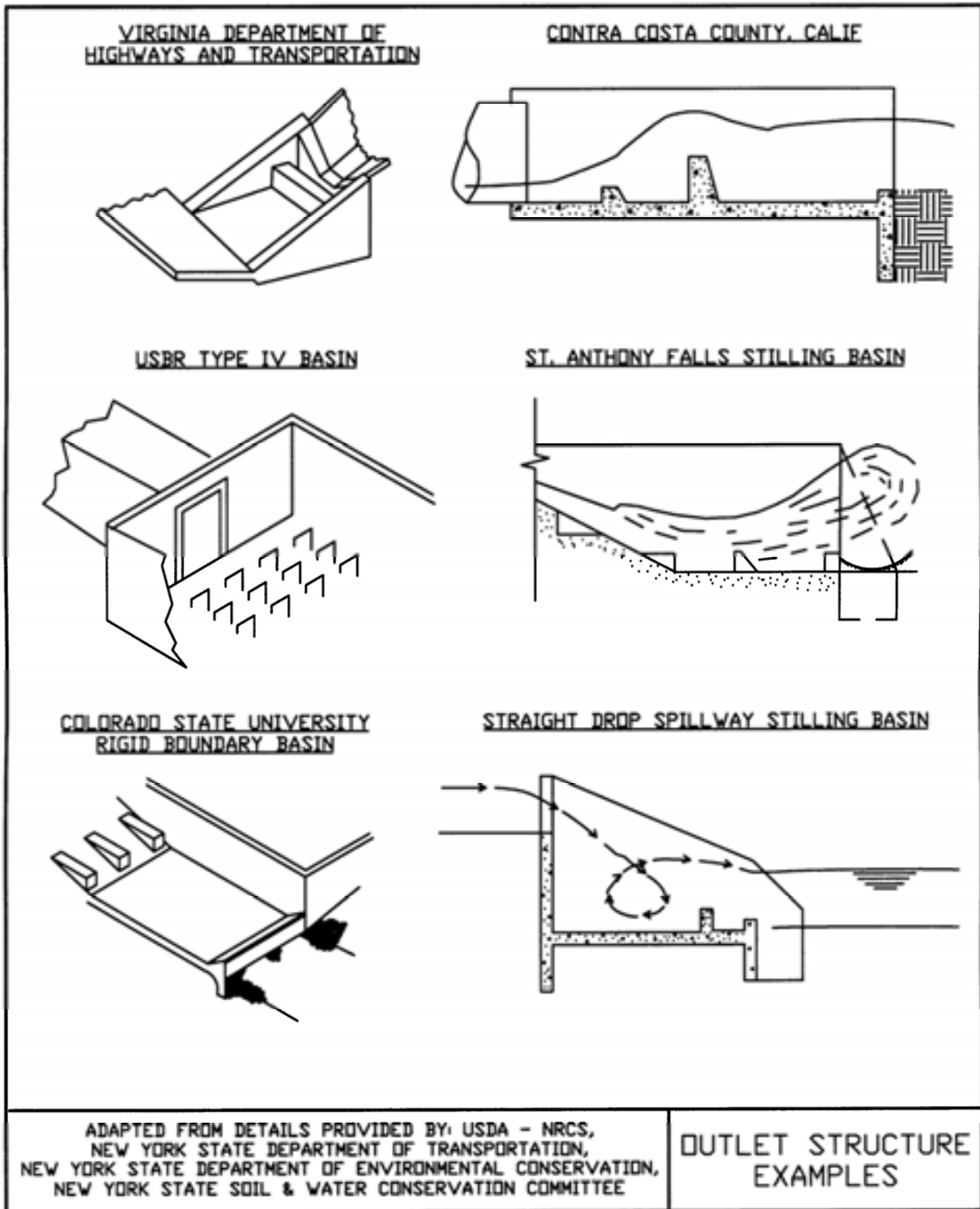
Construction Specifications

1. The subgrade shall be constructed to the lines and grades shown on the plans. Remove all unsuitable material and replace them if necessary with compacted stable fill materials. Shape subgrade to uniform surface. Where concrete is poured directly on subsoil, maintain it in a moist condition.
2. On fill slopes, the soil adjacent to the chute, for a minimum of 5 feet, must be well compacted.
3. Where drainage filters are placed under the structure, the concrete will not be poured on the filter. A plastic liner, a minimum of 4 mils thick, will be placed to prevent contamination of filter layer.
4. Place concrete for the flume to the thickness shown on the plans and finish according to details. Protect freshly poured concrete from extreme temperatures (hot or cold) and ensure proper curing.
5. Form, reinforce, and pour together cutoff walls, anchor lugs and channel linings. Provide traverse joints to control cracking at 20-foot intervals. Joints can be formed by using a 1/8 inch thick removable template or by sawing to a minimum depth of 1 inch. Flumes longer than 50 feet shall have preformed expansion joints installed.
6. Immediately after construction, all disturbed areas will be final graded and seeded.

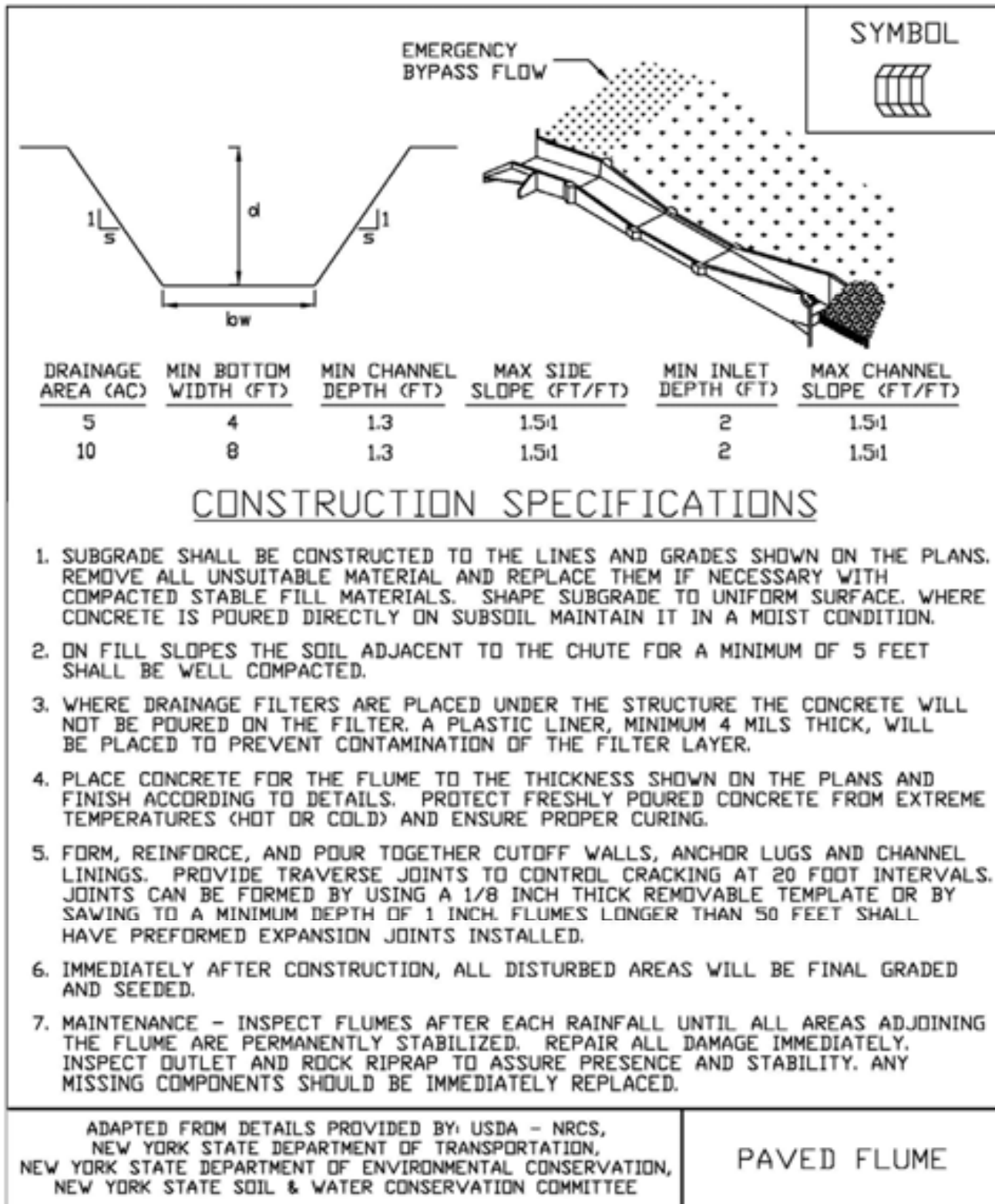
Maintenance

Inspect flumes after each rainfall until all areas adjoining the flume are permanently stabilized. Repair all damage immediately. Inspect outlet and rock riprap to assure presence and stability. Any missing components should be immediately replaced.

Figure 3.12
Examples of Outlet Structures



**Figure 3.13
Paved Flume Detail**



STANDARD AND SPECIFICATIONS FOR PERIMETER DIKE/SWALE



Definition & Scope

A **temporary** ridge of soil formed by excavating an adjoining swale located along the perimeter of the site or disturbed area. Its purpose is to prevent off site storm runoff from entering a disturbed area and to prevent sediment laden storm runoff from leaving the construction site or disturbed area.

Conditions Where Practice Applies

Perimeter dike/swale is constructed to divert flows from entering a disturbed area, or along tops of slopes to prevent flows from eroding the slope, or along base of slopes to direct sediment laden flows to a trapping device.

The perimeter dike/swale shall remain in place until the disturbed areas are permanently stabilized.

Design Criteria

See Figure 3.14 on page 3.36 for details.

The perimeter dike/swale shall not be constructed outside property lines or setbacks without obtaining legal easements from affected adjacent property owners. A design is not required for perimeter dike/swale. The following criteria shall be used:

Drainage area – Less than 2 acres (for drainage areas larger than 2 acres but less than 10 acres, see earth dike or construction ditch; for drainage areas larger than 10 acres, see standard and specifications for diversion).

Height – 18 inches minimum from bottom of swale to top of dike evenly divided between dike height and swale depth.

Bottom width of dike – 2 feet minimum.

Width of swale – 2 feet minimum.

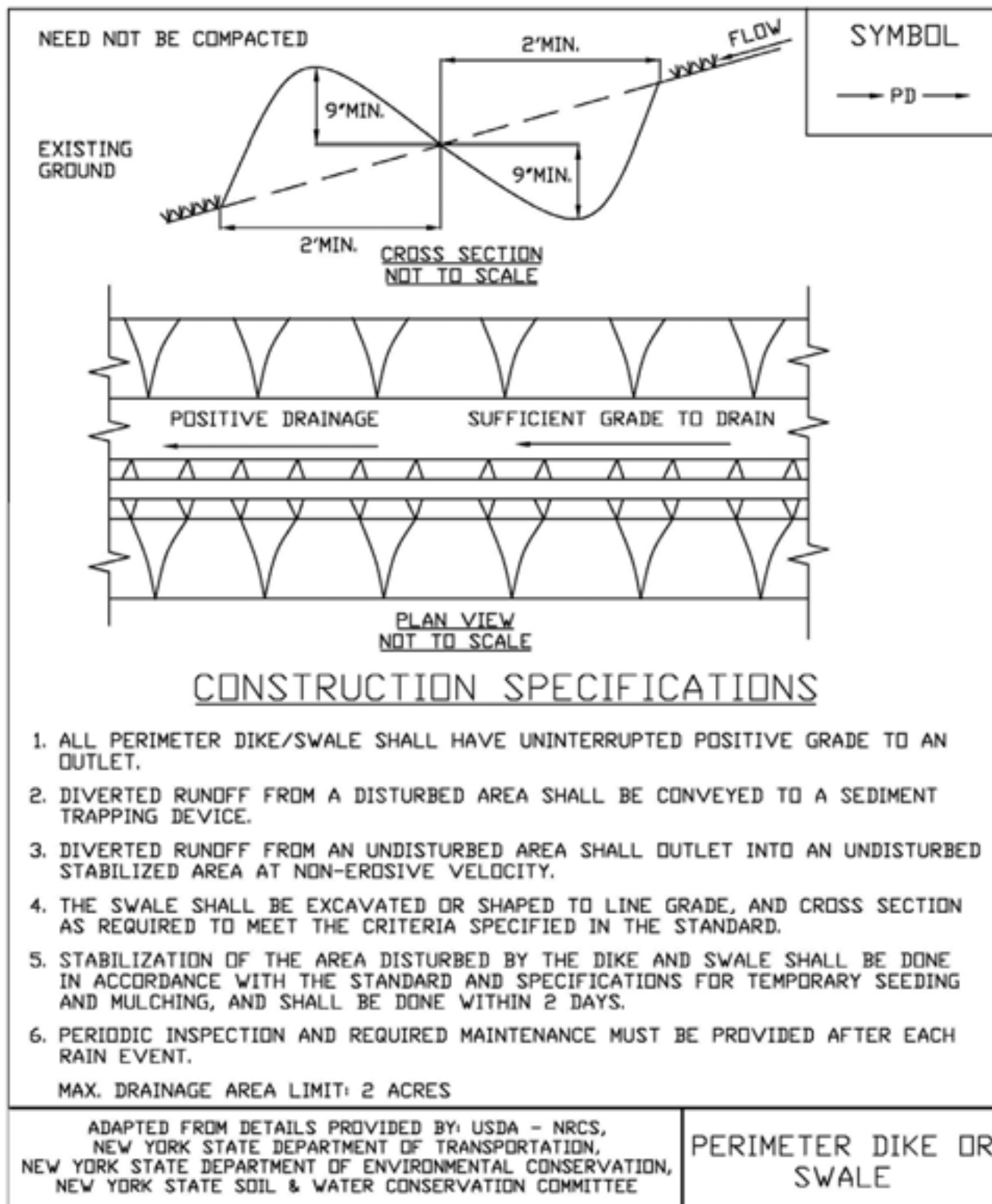
Grade – Dependent upon topography, but shall have positive drainage (sufficient grade to drain) to an adequate outlet. Maximum allowable grade not to exceed 8 percent.

Stabilization – The disturbed area of the dike and swale shall be stabilized within 2 days of installation, in accordance with the standard and specifications for construction ditch (page 3.4).

Outlet

1. Perimeter dike/swale shall have a stabilized outlet.
2. Diverted runoff from a protected or stabilized upland area shall outlet directly onto an undisturbed stabilized area.
3. Diverted runoff from a disturbed or exposed upland area shall be conveyed to a sediment trapping device such as a sediment trap, sediment basin, or to an area protected by any of these practices.
4. The on-site location may need to be adjusted to meet field conditions in order to utilize the most suitable outlet.

**Figure 3.14
Perimeter Dike/Swale Detail**



STANDARD AND SPECIFICATIONS FOR PIPE SLOPE DRAIN



device when the drainage area is disturbed. A riprap apron shall be installed at all pipe outlet locations where water is being discharged.

Construction Specifications

1. The pipe slope drain shall have a slope of 3 percent or steeper.
2. The top of the containment dike over the inlet pipe, and those dikes carrying water to the pipe, shall be at least one (1) foot higher at all points than the top of the inlet pipe.
3. Corrugated plastic pipe or equivalent shall be used with watertight connecting bands.
4. A flared end section shall be attached to the inlet end of pipe with a watertight connection.
5. The soil around and under the pipe and end section shall be hand tamped in 4 in. lifts to the top of the earth dike.
6. Where flexible tubing is used, it shall be the same diameter as the inlet pipe and shall be constructed of a durable material with hold down grommets spaced 10 ft. on centers.
7. The flexible tubing shall be securely fastened to the corrugated plastic pipe with metal strapping or watertight connecting collars.
8. The flexible tubing shall be securely anchored to the slope by staking at the grommets provided.
9. Where a pipe slope drain outlets into a sediment trapping device, it shall discharge at the riser crest or weir elevation.
10. A riprap apron shall be used at all pipe outlet locations. See Figure 3.15 on page 3.38 .
11. Inspection and any needed maintenance shall be performed after each storm event.

Definition & Scope

A **temporary** structure placed from the top of a slope to the bottom of a slope to convey surface runoff down slopes without causing erosion.

Conditions Where Practice Applies

Pipe slope drains are used where concentrated flow of surface runoff must be conveyed down a slope in order to prevent erosion. The maximum allowable drainage area shall be 3.5 acres.

Design Criteria

See Figure 3.15 on page 3.38 for details.

General

Size	Pipe/Tubing Diameter (in.)	Maximum Drainage Area (Ac.)
PSD-12	12	0.5
PSD-18	18	1.5
PSD-21	21	2.5
PSD-24	24	3.5

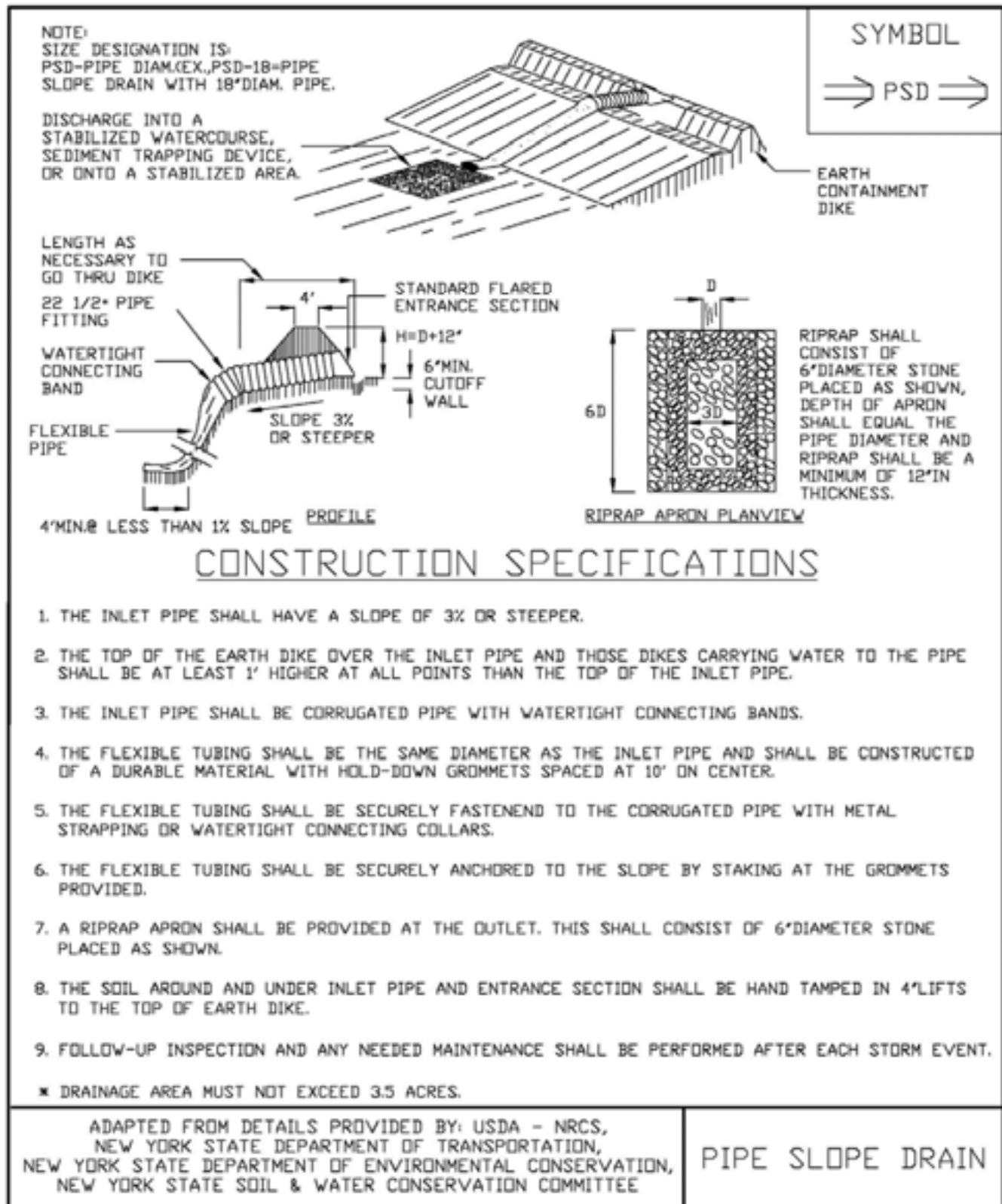
Inlet

The minimum height of the containment dike at the entrance to the pipe slope drain shall be the diameter of the pipe (D) plus 12 inches.

Outlet

The pipe slope drain shall outlet into a sediment trapping

**Figure 3.15
Pipe Slope Drain Detail**



STANDARD AND SPECIFICATIONS FOR ROCK OUTLET PROTECTION



Definition & Scope

A **permanent** section of rock protection placed at the outlet end of the culverts, conduits, or channels to reduce the depth, velocity, and energy of water, such that the flow will not erode the receiving downstream reach.

Conditions Where Practice Applies

This practice applies where discharge velocities and energies at the outlets of culverts, conduits, or channels are sufficient to erode the next downstream reach. This applies to:

1. Culvert outlets of all types.
2. Pipe conduits from all sediment basins, dry storm water ponds, and permanent type ponds.
3. New channels constructed as outlets for culverts and conduits.

Design Criteria

The design of rock outlet protection depends entirely on the location. Pipe outlet at the top of cuts or on slopes steeper than 10 percent, cannot be protected by rock aprons or riprap sections due to re-concentration of flows and high velocities encountered after the flow leaves the apron.

Many counties and state agencies have regulations and design procedures already established for dimensions, type and size of materials, and locations where outlet protection is required. Where these requirements exist, they shall be followed.

Tailwater Depth

The depth of tailwater immediately below the pipe outlet

must be determined for the design capacity of the pipe. If the tailwater depth is less than half the diameter of the outlet pipe, and the receiving stream is wide enough to accept divergence of the flow, it shall be classified as a Minimum Tailwater Condition; see Figure 3.16 on page 3.42 as an example. If the tailwater depth is greater than half the pipe diameter and the receiving stream will continue to confine the flow, it shall be classified as a Maximum Tailwater Condition; see Figure 3.17 on page 3.43 as an example. Pipes which outlet onto flat areas with no defined channel may be assumed to have a Minimum Tailwater Condition; see Figure 3.16 on page 3.42 as an example.

Apron Size

The apron length and width shall be determined from the curves according to the tailwater conditions:

Minimum Tailwater – Use Figure 3.16 on page 3.42

Maximum Tailwater – Use Figure 3.17 on page 3.43

If the pipe discharges directly into a well defined channel, the apron shall extend across the channel bottom and up the channel banks to an elevation one foot above the maximum tailwater depth or to the top of the bank, whichever is less.

The upstream end of the apron, adjacent to the pipe, shall have a width two (2) times the diameter of the outlet pipe, or conform to pipe end section if used.

Bottom Grade

The outlet protection apron shall be constructed with no slope along its length. There shall be no overfall at the end of the apron. The elevation of the downstream end of the apron shall be equal to the elevation of the receiving channel or adjacent ground.

Alignment

The outlet protection apron shall be located so that there are no bends in the horizontal alignment.

Materials

The outlet protection may be done using rock riprap, grouted riprap, or gabions. Outlets constructed on the bank of a stream or wetland shall not use grouted rip-rap, gabions or concrete.

Riprap shall be composed of a well-graded mixture of rock size so that 50 percent of the pieces, by weight, shall be larger than the d_{50} size determined by using the charts. A

well-graded mixture, as used herein, is defined as a mixture composed primarily of larger rock sizes, but with a sufficient mixture of other sizes to fill the smaller voids between the rocks. The diameter of the largest rock size in such a mixture shall be 1.5 times the d_{50} size.

Thickness

The minimum thickness of the riprap layer shall be 1.5 times the maximum rock diameter for d_{50} of 15 inches or less; and 1.2 times the maximum rock size for d_{50} greater than 15 inches. The following chart lists some examples:

D₅₀ (inches)	d_{max} (inches)	Minimum Blanket Thick- ness (inches)
4	6	9
6	9	14
9	14	20
12	18	27
15	22	32
18	27	32
21	32	38
24	36	43

Rock Quality

Rock for riprap shall consist of field rock or rough unhewn quarry rock. The rock shall be hard and angular and of a quality that will not disintegrate on exposure to water or weathering. The specific gravity of the individual rocks shall be at least 2.5.

Filter

A filter is a layer of material placed between the riprap and the underlying soil surface to prevent soil movement into and through the riprap. Riprap shall have a filter placed under it in all cases.

A filter can be of two general forms: a gravel layer or a plastic filter cloth. The plastic filter cloth can be woven or non-woven monofilament yarns, and shall meet these base requirements: thickness 20-60 mils, grab strength 90-120 lbs; and shall conform to ASTM D-1777 and ASTM D-1682.

Gravel filter blanket, when used, shall be designed by comparing particle sizes of the overlying material and the base material. Design criteria are available in Standard and Specification for Anchored Slope and Channel Stabilization on page 4.7.

Gabions

Gabions shall be made of hexagonal triple twist mesh with heavily galvanized steel wire. The maximum linear dimension of the mesh opening shall not exceed 4 ½ inches and the area of the mesh opening shall not exceed 10 square inches.

Gabions shall be fabricated in such a manner that the sides, ends, and lid can be assembled at the construction site into a rectangular basket of the specified sizes. Gabions shall be of single unit construction and shall be installed according to manufacturer’s recommendations.

The area on which the gabion is to be installed shall be graded as shown on the drawings. Foundation conditions shall be the same as for placing rock riprap, and filter cloth shall be placed under all gabions. Where necessary, key, or tie, the structure into the bank to prevent undermining of the main gabion structure.

Maintenance

Once a riprap outlet has been installed, the maintenance needs are very low. It should be inspected after high flows for evidence of scour beneath the riprap or for dislodged rocks. Repairs should be made immediately.

Design Procedure

1. Investigate the downstream channel to assure that nonerosive velocities can be maintained.
2. Determine the tailwater condition at the outlet to establish which curve to use.
3. Use the appropriate chart with the design discharge to determine the riprap size and apron length required. It is noted that references to pipe diameters in the charts are based on full flow. For other than full pipe flow, the parameters of depth of flow and velocity must be used to adjust the design discharges.
4. Calculate apron width at the downstream end if a flare section is to be employed.

Design Examples are demonstrated in Appendix B.

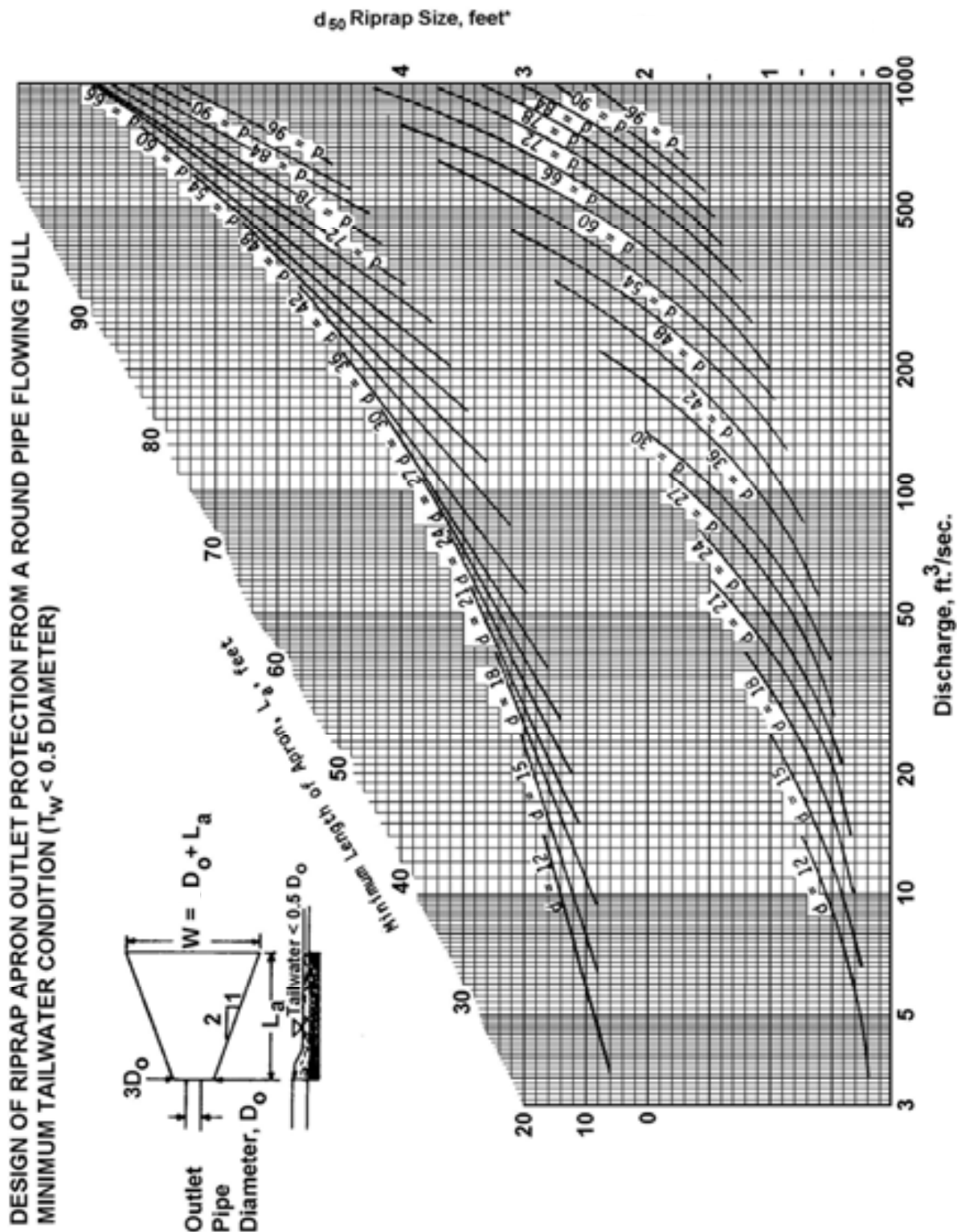
Construction Specifications

1. The subgrade for the filter, riprap, or gabion shall be prepared to the required lines and grades. Any fill required in the subgrade shall be compacted to a density of approximately that of the surrounding undisturbed material.
2. The rock or gravel shall conform to the specified grad-

ing limits when installed respectively in the riprap or filter.

3. Filter cloth shall be protected from punching, cutting, or tearing. Any damage other than an occasional small hole shall be repaired by placing another piece of cloth over the damaged part or by completely replacing the cloth. All overlaps, whether for repairs or for joining two pieces of cloth shall be a minimum of one foot.
4. Rock for the riprap or gabion outlets may be placed by equipment. Both shall each be constructed to the full course thickness in one operation and in such a manner as to avoid displacement of underlying materials. The rock for riprap or gabion outlets shall be delivered and placed in a manner that will ensure that it is reasonably homogenous with the smaller rocks and spalls filling the voids between the larger rocks. Riprap shall be placed in a manner to prevent damage to the filter blanket or filter cloth. Hand placement will be required to the extent necessary to prevent damage to the permanent works.

Figure 3.16
Outlet Protection Design—Minimum Tailwater Condition Chart
(Design of Outlet Protection from a Round Pipe Flowing Full,
Minimum Tailwater Condition: $T_w < 0.5D_o$) (USDA - NRCS)



* For discharge velocities exceeding Maximum A for riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

Figure 3.17
Outlet Protection Design—Maximum Tailwater Condition Chart
(Design of Outlet Protection from a Round Pipe Flowing Full,
Maximum Tailwater Condition: $T_w \geq 0.5D_o$) (USDA - NRCS)

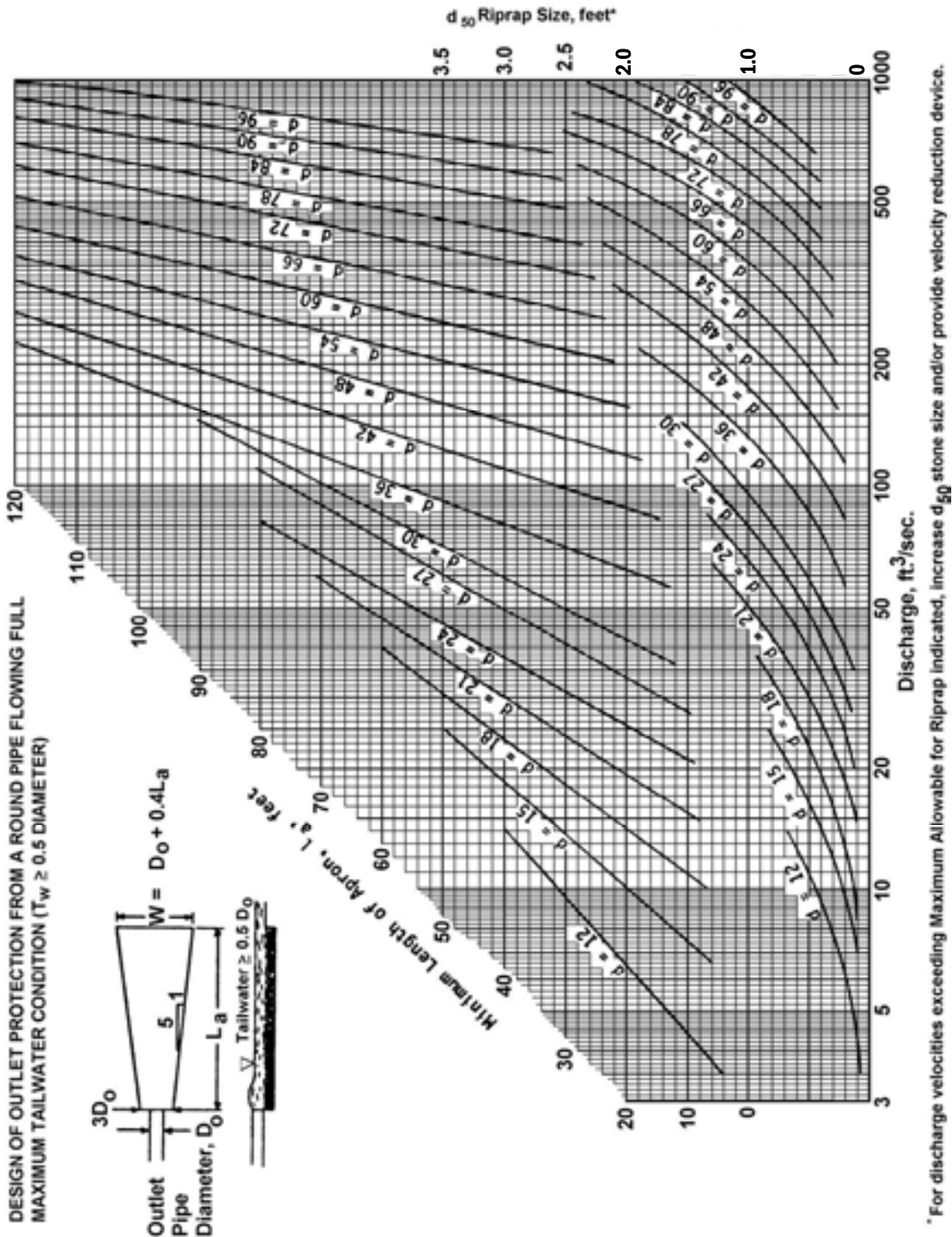
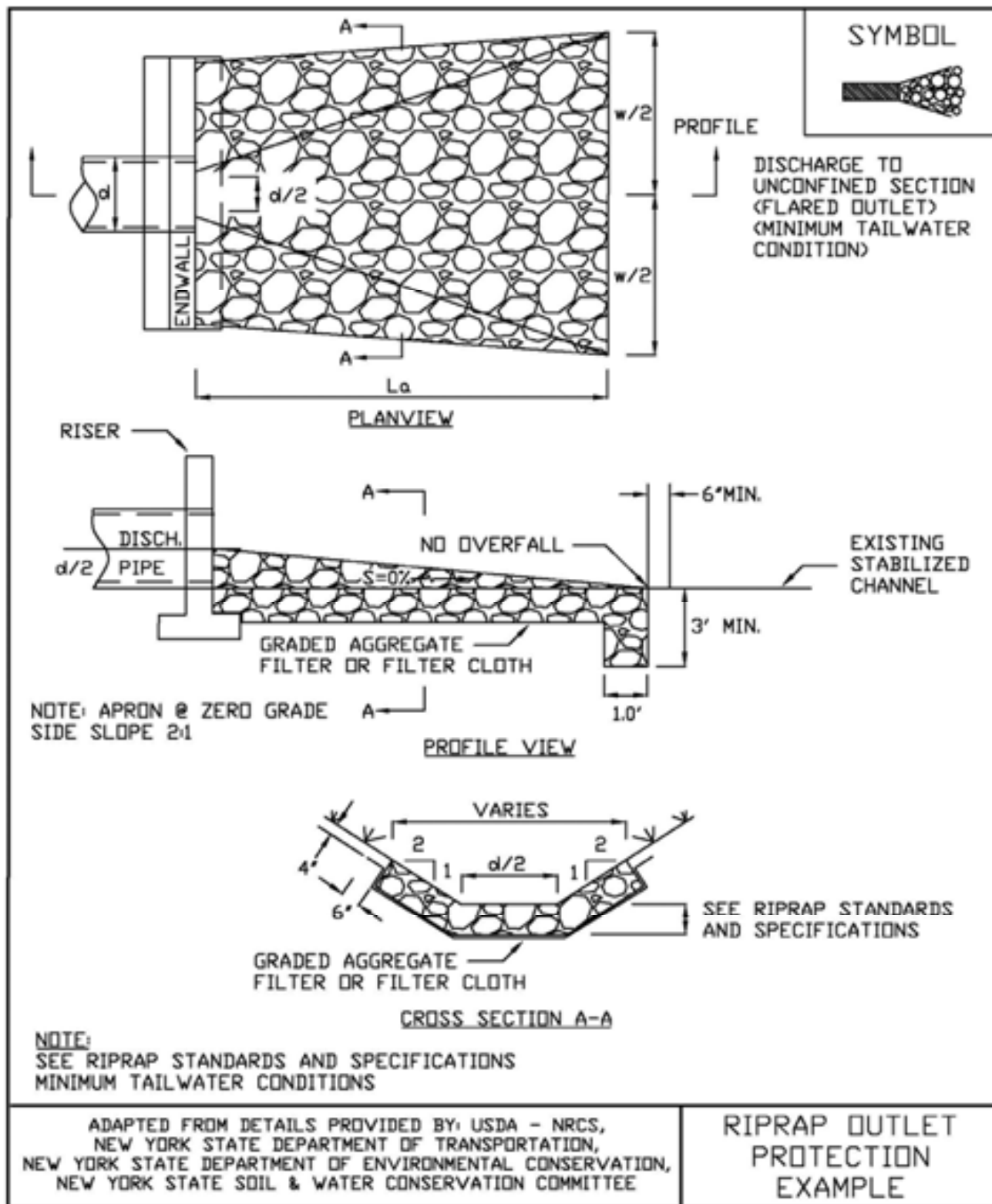
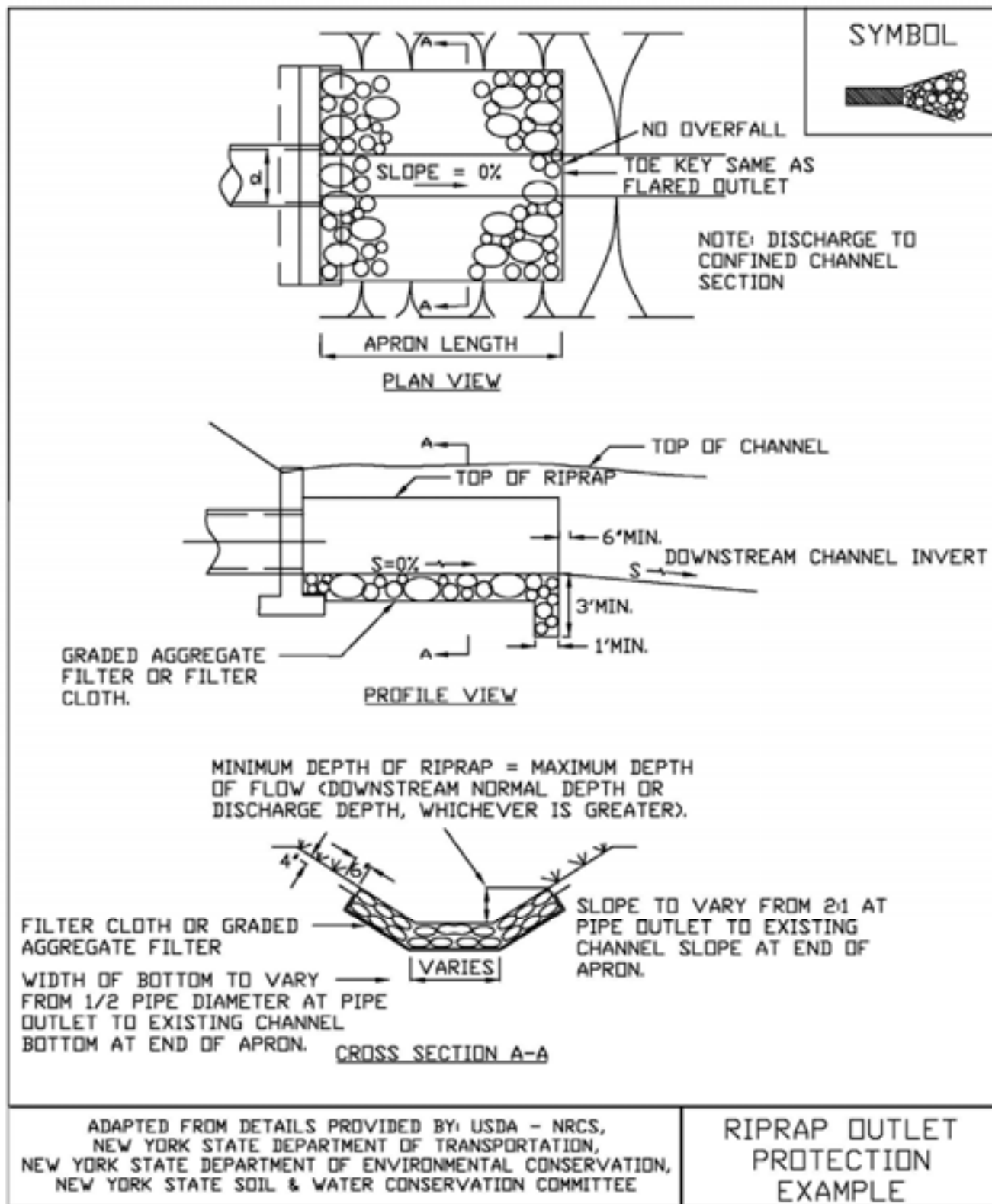


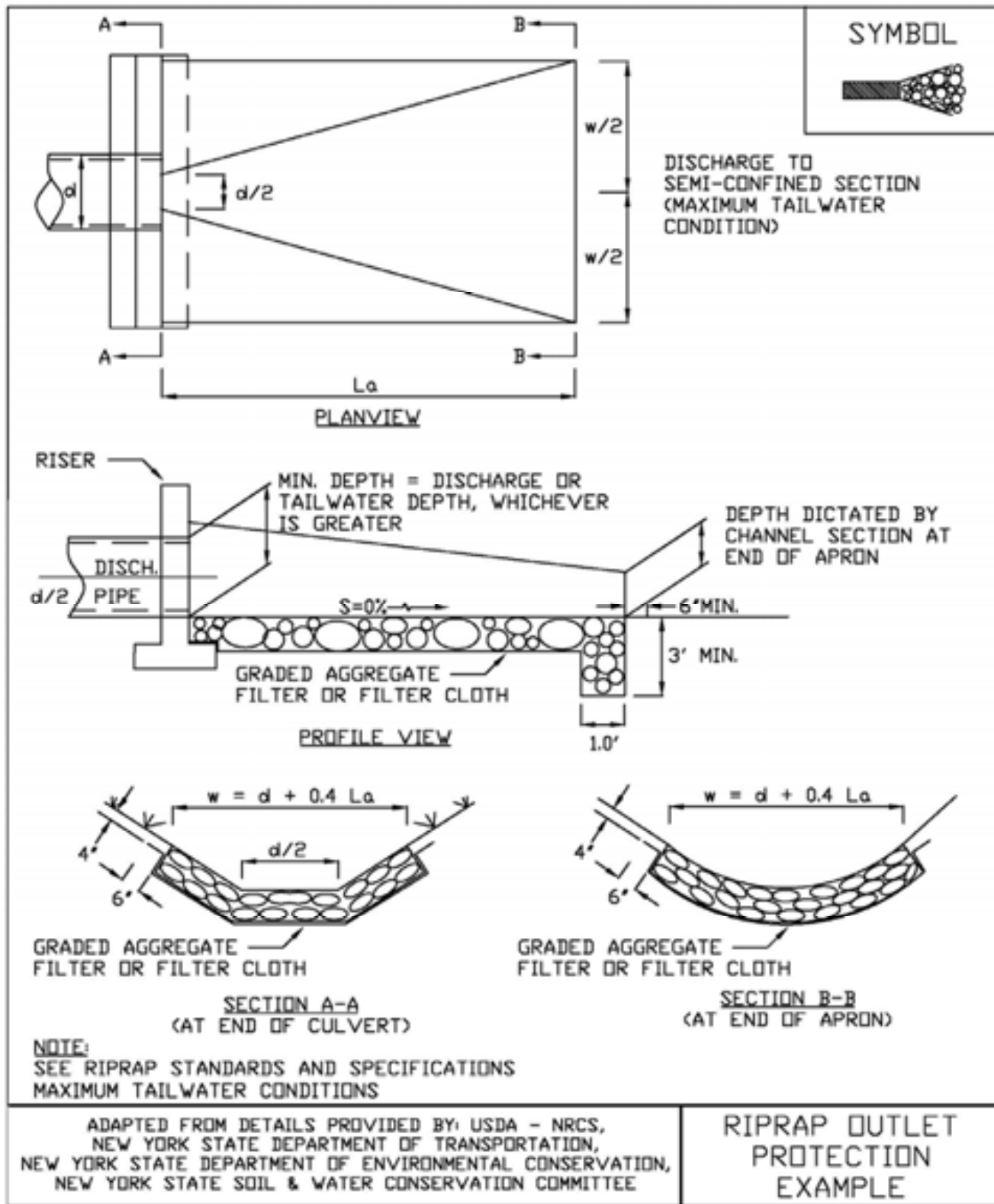
Figure 3.18
Riprap Outlet Protection Detail (1)



**Figure 3.19
Riprap Outlet Protection Detail (2)**



**Figure 3.20
Riprap Outlet Protection Detail (3)**



STANDARD AND SPECIFICATIONS FOR STORM DRAIN DIVERSION



Definition & Scope

The **temporary** redirection of a storm drain line or outfall channel so that it may discharge into a sediment trapping device in order to prevent sediment laden water from entering a watercourse, public or private property through a storm drain system. This could either be above ground or an underground conveyance system to convey sediment laden water to a sediment trapping device.

Conditions Where Practice Applies

One of the following practices or procedures shall be used whenever the off-site drainage area is less than 50 percent of the on-site drainage area to that system. A special exception may be given, at the discretion of the local plan approval agency, where site conditions make this procedure impossible.

Method of Temporary Diversion

1. Construction of a sediment trap or basin below a permanent storm drain outfall. Temporarily diverts storm flow into the basin or trap constructed below permanent outfall channel.
2. In-line diversion of storm drain at an inlet or manhole, achieved by installing a pipe stub in the side of a manhole or inlet and temporarily blocking the permanent outfall pipe from that structure. A temporary outfall ditch or pipe may be used to convey storm flow from the stub to a sediment trap or basin. This method may be used just above a permanent outfall or prior to connecting into an existing storm drain system.
3. Delay completion of the permanent storm drain outfall and temporarily divert storm flow into a sediment basin or trap. Earth dike, swale or design diversion is used, depending on the drainage area, to direct flow into a sediment basin or trap. The basin or trap should be constructed to one side of the proposed permanent storm drain location whenever possible.
4. Installation of a stormwater management basin early in the construction sequence. Install temporary measures to allow use of this site as a sediment basin. Since these structures are designed to receive storm drain outfalls, diversion should not be necessary.

Completion and Disposition

When the areas contributing sediment to the system have been stabilized, procedures can be taken to restore the system to its planned use.

The following removal and restoration procedure is recommended:

1. Flush the storm drain system to remove any accumulated sediment.
2. Remove the sediment control devices, such as traps, basins, dikes, swales, etc.
3. For sites where an inlet was modified, brick and grout shut the temporary pipe stub and open the permanent outfall pipe.
4. Establish permanent stabilized outfall channel as noted on the plans.
5. Restore the area to grades shown on the plan and stabilize with vegetative measures.
6. For basins that will be incorporated into stormwater management facilities, remove the accumulated sediment, construct the stormwater facility as designed, and seed all disturbed areas to permanent vegetation.

STANDARD AND SPECIFICATIONS FOR SUBSURFACE DRAIN



Definition & Scope

A **permanent** conduit, such as tile, pipe, or tubing, installed beneath the ground surface, which intercepts, collects, and/or conveys drainage water to serve one or more of the following purposes:

1. Improve the environment for vegetative growth by regulating the water table and groundwater flow.
2. Intercept and prevent water movement into a wet area.
3. Relieve artesian pressures.
4. Remove surface runoff.
5. Provide internal drainage of slopes to improve their stability and reduce erosion.
6. Provide internal drainage behind bulkheads, retaining walls, etc.
7. Replace existing subsurface drains that are interrupted or destroyed by construction operations.
8. Provide subsurface drainage for dry storm water management structures.
9. Improve dewatering of sediment in sediment basins. (See Standard and Specification for Sediment Basins in Section 5).

Conditions Where Practice Applies

Subsurface drains are used in areas having a high water table or where subsurface drainage is required. The soil shall have enough depth and permeability to permit installation of an effective system. This standard does not apply to

storm drainage systems or foundation drains. Regulatory restrictions may apply if wetlands are present.

An outlet for the drainage system shall be available, either by gravity flow or by pumping. The outlet shall be adequate for the quantity of water to be discharged without causing damage above or below the point of discharge and shall comply with all state and local laws.

Design Criteria

The design and installation shall be based on adequate surveys and on-site soils investigations.

Required Capacity of Drains

The required capacity shall be determined by one or more of the following:

1. Where sub-surface drainage is to be uniform over an area through a systematic pattern of drains, a drainage coefficient of 1 inch to be removed in 24 hours shall be used; see Drain Chart, Figure 3.21 on page 3.51.
2. Where sub-surface drainage is to be by a random interceptor system, a minimum inflow rate of 0.5 cfs per 1,000 feet of line shall be used to determine the required capacity. If actual field tests and measurements of flow amounts are available, they may be used for determining capacity.

For interceptor subsurface drains on sloping land, increase the inflow rate as follows:

Land Slope	Increase Inflow Rate By
2-5 percent	10 percent
5-12 percent	20 percent
Over 12 percent	30 percent

3. Additional design capacity must be provided if surface water is allowed to enter the system.

Size of Subsurface Drain

The size of subsurface drains shall be determined from the drain chart found on Figures 3.21 on page 3.51. All subsurface drains shall have a nominal diameter, which equals or exceeds four (4) inches.

Depth and Spacing

The minimum depth of cover of subsurface drains shall be 24 inches where possible. The minimum depth of cover may be reduced to 15 inches where it is not possible to attain the 24 inch depth and where the drain is not subject to equipment loading or frost action. Roots from some types of vegetation can plug drains, as the drains get closer to the surface.

The spacing of drain laterals will be dependent on the permeability of the soil, the depth of installation of the drains and degree of drainage required. Generally, drains installed 36 inches deep and spaced 50 feet center-to-center will be adequate. For more specific information, see the [New York Drainage Guide \(USDA-NRCS\)](#).

Minimum Velocity and Grade

The minimum grade for subsurface drains shall be 0.10 percent. Where surface water enters the system a velocity of not less than 2 feet per second shall be used to establish the minimum grades. Provisions shall be made for preventing debris or sediment from entering the system by means of filters or collection and periodic removal of sediment from installed traps.

Materials for Subsurface Drains

Acceptable subsurface drain materials include perforated, continuous closed joint conduits of polyethylene plastic, concrete, corrugated metal, polyvinyl chloride, and clay tile.

The conduit shall meet strength and durability requirements of the site.

Loading

The allowable loads on subsurface drain conduits shall be based on the trench and bedding conditions specified for the job. A factor of safety of not less than 1.5 shall be used in computing the maximum allowable depth of cover for a particular type of conduit.

Envelopes and Envelope Materials

Envelopes shall be used around subsurface drains for proper bedding and to provide better flow into the conduit. Not less than three inches of envelope material shall be used for sand/gravel envelopes. Where necessary to improve the characteristics of flow of groundwater into the conduit, more envelope material may be required.

Where county regulations do not allow sand/gravel envelopes, but require a special type and size of envelope material, they shall be followed.

Envelope material shall be placed to the height of the upper-

most seepage strata. Behind bulkheads and retaining walls, it shall go to within twelve inches of the top of the structure. This standard does not cover the design of filter materials where needed.

Materials used for envelopes shall not contain materials which will cause an accumulation of sediment in the conduit or render the envelope unsuitable for bedding of the conduit. Envelope materials shall consist of either filter cloth or sand/gravel material, which shall pass a 1 ½ inch sieve, 90 to 100 percent shall pass a ¾ inch sieve, and not more than 10 percent shall pass a No. 60 sieve.

Filter cloth envelope can be either woven or non-woven monofilament yarns and shall have a sieve opening ranging from 40 to 80. The envelope shall be placed in such a manner that once the conduit is installed, it shall completely encase the conduit.

The conduit shall be placed and bedded in a sand/gravel envelope. A minimum of three inches depth of envelope materials shall be placed on the bottom of a conventional trench. The conduit shall be placed on this and the trench completely filled with envelope material to minimum depth of 3 inches above the conduit.

Soft or yielding soils under the drain shall be stabilized where required and lines protected from settlement by adding gravel or other suitable material to the trench, by placing the conduit on plank or other rigid support, or by using long sections of perforated or watertight pipe with adequate strength to ensure satisfactory subsurface drain performance.

Use of Heavy Duty Corrugated Plastic Drainage Tubing

Heavy duty corrugated drainage tubing shall be specified where rocky or gravelly soils are expected to be encountered during installation operations. The quality of tubing will also be specified when cover over this tubing is expected to exceed 24 inches for 4, 5, 6, or 8 inch tubing. Larger size tubing designs will be handled on an individual job basis.

Auxiliary Structure and Subsurface Drain Protection

The outlet shall be protected against erosion and undermining of the conduit, against damaging periods of submergence, and against entry of rodents or other animals into the subsurface drain. An animal guard shall be installed on the outlet end of the pipe. A swinging animal guard shall be used if surface water enters the pipe.

A continuous 10-foot section of corrugated metal, cast iron, polyvinyl chloride, or steel pipe without perforations shall be used at the outlet end of the line and shall outlet 1.0 foot above the normal elevation of low flow in the outlet ditch or

above mean high tide in tidal areas. No envelope material shall be used around the 10-foot section of pipe. Two-thirds of the pipe shall be buried in the ditch bank and the cantilevered section shall extend to a point above the toe of the ditch side slope. If not possible, the side slope shall be protected from erosion.

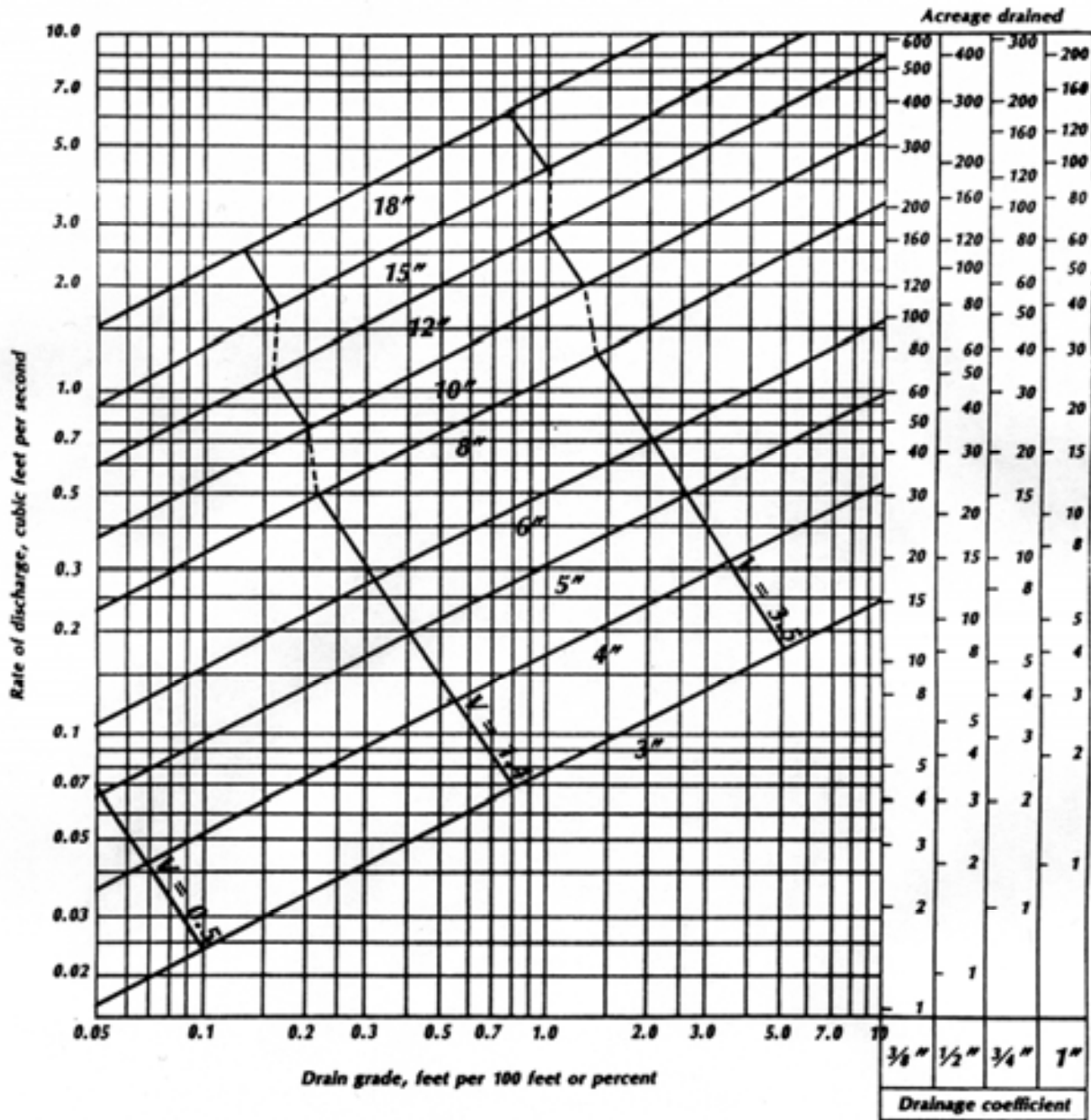
Conduits under roadways and embankments shall be watertight and designed to exclude debris and prevent sediment from entering the conduit. Lines flowing under pressure shall be designed to withstand the resulting pressures and velocity of flow. Surface waterways shall be used where feasible.

The upper end of each subsurface drain line shall be capped with a tight fitting cap of the same material as the conduit or other durable material unless connected to a structure.

Construction Specifications

1. Deformed, warped, or otherwise damaged pipe or tubing shall not be used.
2. All subsurface drains shall be laid to a uniform line and covered with envelope material. The pipe or tubing shall be laid with the perforations down and oriented symmetrically about the vertical centerline. Connections will be made with manufactured appurtenances comparable in strength with the specified pipe or tubing unless otherwise specified. The method of placement and bedding shall be as specified on the drawing.
3. Envelope material shall consist of filter cloth or a sand/gravel (which shall pass the 1 ½ inch sieve, 90 to 100 percent shall pass ¾ inch sieve, and not more than 10 percent shall pass the No. 60 sieve).
4. The upper end of each subsurface drain line shall be capped with a tight fittings cap of the same material as the conduit or other durable material unless connected to a structure.
5. A continuous 10-foot section of corrugated metal, cast iron, polyvinyl chloride, or steel pipe without perforations shall be used at the outlet end of the line. No envelope material shall be used around the 10-foot section of the pipe. An animal guard shall be installed on the outlet end of the pipe.
6. Earth backfill material shall be placed in the trench in such a manner that displacement of the drain will not occur.
7. Where surface water is entering the system, the pipe outlet section of the system shall contain a swing type trash and animal guard.

Figure 3.21
Drain Chart - Corrugated Plastic Drain Tubing (USDA-NRCS)



STANDARD AND SPECIFICATIONS FOR WATER BAR



Definition & Scope

A **permanent** or **temporary** ridge, ridge and channel, a structural channel, or flow deflector, constructed diagonally across a sloping road or utility right-of-way that is subject to erosion to limit the accumulation of erosive velocity of water by diverting surface runoff at pre-designed intervals.

Conditions Where Practice Applies

Where runoff protection is needed to prevent erosion from increased concentrated flow on narrow, steep access roads, driveways, and entrance ways to lot parcels as well as utility access right-of-ways generally up to 100 feet in width

Design Criteria

Design computations are not required.

1. The design height shall be minimum of 12 inches measured from channel bottom to ridge top.
2. The side slopes shall be 2:1 or flatter, a minimum of 4:1 where vehicles cross.
3. The base width of the ridge shall be six feet minimum.
4. The spacing of the water bars shall be as follows (Site spacing may need to be adjusted for field conditions to use the most suitable areas for water disposal):

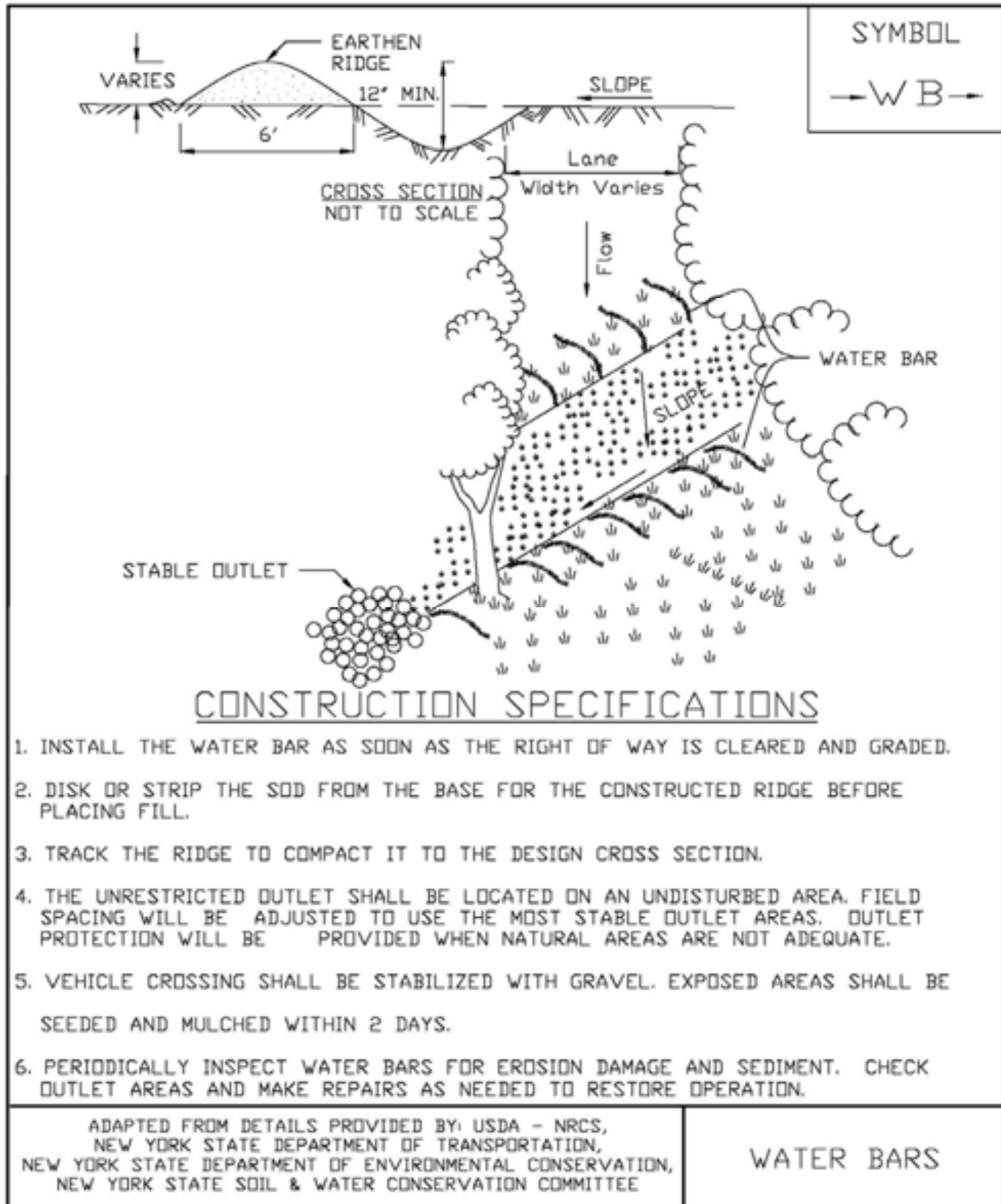
Slope (%)	Spacing (ft.)
<5	125
5 TO 10	100
10 TO 20	75
20 TO 35	50
>35	25

5. The positive grade of the water bar shall not exceed 2%. A crossing angle of approximately 60 degrees is preferred.
6. Once diverted, water must be conveyed to a stable system (i.e. vegetated swale or storm sewer system). Water bars should have stable, unrestricted outlets, either natural or constructed.

See Figure 3.22 on page 3.53 for details.



Figure 3.22
Water Bar Detail



SECTION 4
EROSION CONTROL - PART 2
SOIL STABILIZATION

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EROSION CONTROL - PART 2

SOIL STABILIZATION

Scope and Discussion

Soil stabilization is the second step in controlling erosion on a construction site or a disturbed area. Erosion is the gradual wearing away of the land surface as a result of uncontrolled wind and water energy. Sedimentation is the result of transport and delivery of eroded particles, deposited at some point. Erosion and sediment control is a complex interaction of soils, engineering water management, agronomic, and horticultural practices. Decisions for resolving erosion conditions, both on the site and within the upper watershed, are formulated based on surface and subsurface water, soil material, climatic conditions, and anticipated land use. Creating a stable slope is necessary prior to vegetating. Sloughing and slumping impede establishment of a uniform protective cover. Stabilizing onsite surfaces can be done with vegetation in the form of various seed mixes and mulch, land shaping, and using woody plants specifically selected for site specific applications, also known as a bio-technical stabilization approach.

General planning considerations for vegetating a steep slope will include evaluating the soil. Factors such as soil texture and steepness affect the stability of the slope. Texture also influences the permeability and water holding capacity of the soil. Many slopes are stripped of their topsoil during the construction phase, leaving an infertile, compacted soil surface, void of valuable organic matter. Topsoil must be reapplied. Overly compacted soil must be decompacted with appropriate equipment. Soil pH and nutrient level are determined by obtaining a representative soil sample for analysis from an accredited lab. Appropriate plant material is designed and selected to meet the final slope and soil conditions for the site. These same concerns and practices also apply to flatter slopes and level areas.

When specifying a fertilizer mix for an area, design the appropriate proportions to meet the nutrients needs for the specific site. Always apply as closely as possible the required amount of fertilizer to meet the needs for the site soils. Adding surplus nitrogen may cause pollution of drinking water and saltwater ecosystems. Excessive phosphorus may accelerate the aging process of freshwater ecosystems. Excessive amounts of Nitrogen (N) and Potassium Oxide (K₂O) may result in 'burning' the grass and killing it. **All fertilizer applications will be in accordance with the Nutrient Runoff Law – ECL Article 17, Title 21, January 1, 2012.**

Principles of Biotechnical Practices

The implementation of Biotechnical practices is the specialized use of woody plant materials to stabilize soil enhance structural practices, and provide added support to habitat. One of the factors that affects erosion is vegetative cover. The more cover soil has, the more protected it is from the attacking forces of rainfall and runoff. Also working to hold the soil in place is the root mass that vegetation produces. Biotechnical measures generally combine basic engineering principles with plant science to create a system of stability and resource management for critical areas such as streambanks, roadside slopes, and large exposed areas. These systems may combine with structural measures to effect a strengthening of the soil structure and improve vegetative cover to resist surface erosion.

There are many advantages to Biotechnical practices:

- they are often less expensive to install
- they do not require specialized skills to install
- generally, heavy equipment is not required
- they are environmentally compatible since the design selects natural and native plant materials
- they provide a natural aesthetic appearance
- they provide wildlife habitat and cover and provide a food source to many land and aquatic species
- they mitigate thermal impacts to structural stream stabilization practices such as rock riprap and retaining walls by providing shade
- they can be self repairing during and after stress

On the other hand, there are some disadvantages to these measures:

- requires planning to obtain sources of plant materials
- higher risk due to less control with vegetation compared to structural practices
- require higher maintenance attention
- need an establishment period
- more sensitive to seasonal changes and seasonal

restrictions on planting may apply

The use of Biotechnical practices is actually an old technology. These techniques have been practiced for centuries in Europe. The Natural Resource Conservation Service used and promoted this technology in the 1940's in Vermont on the Winooski River and also in New York on Buffalo Creek, where plant materials (willows) were used in combination with rock riprap, concrete slabs, pinned rock, and cellular modules to halt streambank erosion.

These biotechnical approaches have been “rediscovered” primarily due to their cost effectiveness over more traditional structural measures (hard armor) and for their environmental compatibility, aesthetics, and wildlife benefits. There are many areas in towns and counties in New York that experience erosion on streambanks or sloughs on roadside slopes that could be controlled with biotechnical protection measures. The low cost and ease of installation is very attractive to units of government and highway departments looking to maximize their budget dollars.

Generally a biotechnical slope protection system consists of both a structural or mechanical element and vegetative elements working together to stabilize a site-specific condition. Structural components are employed in such a way to allow establishment of vegetative elements, while at the same time providing a level of protection for stability. The vegetative components are not just landscaping plantings for a structural project; they also perform a functional role in preventing erosion by protecting the surface, while also stabilizing soil by preventing shallow mass movements. These practices also provide a food source to both land based animals as well as smaller aquatic species along streambank revetments. Once established, the plantings provide shade in areas where mitigation of thermal impacts is needed due to hardened structural practices.

Woody plant materials (usually dormant shrub willow branches) are placed into the soil in ways that provide an immediate degree of stability to the slope. As the branches take root and grow, the slope becomes more and more resistant to failure by shallow mass movements due to:

1. Mechanical reinforcement from the root system,
2. Soil moisture reduction through transpiration and plant uptake, and
3. Buttressing and soil arching action from embedded stems.

The vegetation also tends to prevent (surface) erosion by:

1. Binding and restraining soil particles in place,
2. Filtering soil particles from runoff,
3. Absorb raindrop energy prior to impact,
4. Retarding velocity of runoff, and
5. Maintaining infiltration.

As the stability improves, native vegetation will volunteer, helping to blend the site into the surroundings.

There are many techniques used in biotechnical work. Some of the most common are:

Vegetated Rock Gabions—This is a combination of vegetation and rock gabions generally used for slope stabilization. Live branch cuttings are layered through the rock gabion structure to anchor in select earthfill. The cuttings protrude beyond the face of the gabion. The gabion standard is covered in the “Standard Specifications for Retaining Walls”. See Figure 4.20 on page 4.67 for details.

Live Fascines—This technique uses bundles of branches which are staked into shallow trenches, then filled with soil. They are oriented along the contour and are placed in multiple rows to help stabilize a slope. See Standard and Specifications for Live Fascines.

Brush Mattress—This method uses hardwood brush layered along a streambank as a mattress and anchored in place with a grid of stakes and wire. The toe below the waterline is anchored by rock. This living blanket acts as a mulch for seedlings and plantings established in the bank. It also prevents erosion of sloped surfaces. See Standards and Specifications for Brush Mattress.

Live Staking—These are large stakes or poles sharpened at the bottom end and forced vertically into the soft earth along the waterline, usually about 1 foot apart. Depending on the size of the poles and the composition of the streambank, machinery may be required to force them into the ground or to prepare holes for planting. The poles will grow forming a very thick barrier to flow. See Figure 4.14 and Figure 4.15.

Brush Layering—This technique is generally used to stabilize slope areas above the flow line of streambanks as well as cut and fill slopes. It involves the use of long branches that are placed with cut ends into the slope on bulldozed terraces. The tops protrude outside the finished slope. A layer usually includes three layers of brush separated with a thin (3 in.) layer of soil. On this layer a “lift” of 3-5 feet of soil is placed to form the next terrace and so forth. See Figure 4.6.

Live Cribwall—This is a combination of vegetation and structural elements generally used along streams where flowing water is a hazard. Layers of logs are alternated with long branches protruding out between them. The logs are spiked together and anchored into the bank with earthfill behind them to create a wall. The live stems help tie the logs together and screen the wall. See Figure 4.12.

Tree Revetment—This method incorporates entire trees (without the root wad) for bank stabilization in areas that are eroded or undercut, but not flashy or in need of heavy maintenance. Trees are overlapped and anchored to the earth for the purpose of absorbing energy and reducing velocity, capturing sediment, and enhancing conditions for colonization of native species. See Figure 4.19.

Branchpacking—This technique alternates live branch cuttings with tamped backfill to repair small, localized slumps and holes in slopes. The alternating layers of branches and soil are placed between long posts driven in to the ground for support. This method is inappropriate for areas larger than 4-feet deep or 6-feet wide. See Figure 4.5.

Fiber Roll—A fiber roll is a coconut fiber, straw, or excelsior woven roll encased in netting of jute, nylon, or burlap used to dissipate energy along bodies of water and provide a good medium for the introduction of herbaceous vegetation. This technique works best where water levels are relatively constant. The roll is anchored into the bank and, after suitable backfill is placed behind the roll, herbaceous or woody vegetation can be planted. See Figure 4.8.

Properly designed structural measures may be necessary to help protect the toe or face of a slope against scour or erosion from moving water and against mass-moving of soil. These structures are generally capable of resisting much higher lateral earth pressures and higher shear values than vegetation. They can be natural, such as fieldstone, rock and timbers; or, they can be artificial like concrete and steel. Some structural measures can be a combination like gabions, which are wire baskets containing stone. Gabions can be used as retaining walls, grade stabilization structures and slope protection. Many of these types of structures can be planted or vegetated with materials to strengthen the system.

Note: Performing activities within or adjacent to wetlands, streams and waterbodies may require permits from the New York State Department of Environmental Conservation (NYSDEC) pursuant to Article 15 (Protection of Waters), Article 24 (Freshwater Wetlands) and Article 25 (Tidal Wetlands) of the Environmental Conservation Law (ECL). Project owners should contact NYSDEC's Regional Division of Environmental Permits early in the site planning process to discuss the requirements for meeting permit issuance standards. Following the New York State Standards and Specifications for Erosion and Sediment Control may not ensure compliance with the above referenced sections of the ECL.

Planning Considerations

There are many facets that need to be considered when designing a biotechnical system for a site:

Method – What is the appropriate method or practice for the particular problem encountered?

Materials – What type should be selected? How much is needed to do the job? Where can they be obtained?

Schedule – When is the best time to maximize the successful rooting or germination of materials?

Equipment – Since this process is somewhat labor intensive, it is necessary to make sure the proper type and amount of tools, such as shovels, pick axe, tile spade, hammers, etc. are available for proper installation of material.

Site characteristics – The need for engineering structures will depend on potential hazards, management of site water, soil conditions, and site access. Aesthetics and follow-up maintenance are also important considerations. Protection from livestock is mandatory.

Streambanks – Generally applicable where flows are less than 6 feet per second and the stream bottom is not subject to degradation and scour. Protection should be carried to the average high water elevation.

Plant Materials

Plant materials for biotechnical slope protection may be obtained in two basic ways. One method is to locate stands of appropriate species and obtain easements to harvest materials from these stands for incorporation into the project. Criteria for selecting native species are: easy rooting; long, straight, flexible whips; and plentiful supply near the site.

A second method is to grow and harvest materials from

managed production beds that are maintained for commercial distribution. This allows selection of cultivars that have proven performance records and high survival rates.

The most popular materials in use today are the shrub willows. Willows have a tremendous ability to sprout roots and stems when in contact with moist soil. Willows are found growing in all parts of the world, so biotechnical slope protection techniques employ them more than any other group of plants. Two of the tested, proven willow cultivars in the Northeast are:

- ‘Streamco’ purple osier willow (*Salix purpurea*)
- ‘Bankers’ dwarf willow (*Salix cottetii* – hybrid)

‘Streamco’ and ‘Bankers’ willow are both shrubs. ‘Streamco’ has an ultimate height of 15-20 feet, while ‘Bankers’ is limited to 6-8 feet. Commercial and state nurseries in the Northeast are producing supplies of both species.

In addition to willows, red osier dogwood and poplars are other groups of plants effective for use in biotechnical systems. Species such as elderberry or forsythia can also be used to add biodiversity to a site.

All plant materials should be installed on site within 8 hours of cutting, unless provisions for proper storage are made. Materials should be fresh, dormant, and non-desiccated when installed.

STANDARD AND SPECIFICATIONS FOR ANCHORED STABILIZATION MATTING



Definition and Scope

A **temporary** or **permanent** protective covering placed on a prepared, seeded planting area that is anchored in place by staples or other means to aid in controlling erosion by absorbing rain splash energy and withstand overland flow as well as provide a microclimate to protect and promote seed establishment.

Conditions Where Practice Applies

Anchored stabilization mats are required for seeded earthen slopes steeper than 3 horizontal to 1 vertical; in vegetated channels where the velocity of the design flow exceeds the allowable velocity for vegetation alone (usually greater than 5 feet per second); on streambanks and shorelines where moving water is likely to erode newly seeded or planted areas; and in areas where wind prevents standard mulching with straw. This standard does not apply to slopes stabilized with sod, rock riprap or hard armor material.

Design Criteria

Slope Applications - Anchored stabilization mats for use on slopes are primarily used as mulch blankets where the mesh material is within the blanket or as a netting over previously placed mulch. These stabilization mats are NOT effective in preventing slope failures.

1. Required on all slopes steeper than 3:1
2. Matting will be designed for proper longevity need and strength based on intended use.
3. All installation details and directions will be included on the site erosion and sediment control plan and will follow manufactures specifications.

Channel Applications - Anchored stabilization mats, for use in supporting vegetation in flow channels, are generally a non-degradable, three dimensional plastic structure which can be filled with soil prior to planting. This structure provides a medium for root growth where the matting and roots become intertwined forming a continuous anchor for the vegetated lining.

1. Channel stabilization shall be based on the tractive force method.
2. For maximum design shear stresses less than 2 pounds per square foot, a temporary or bio-degradable mat may be used.
3. The design of the final matting shall be based on the mats ability to resist the tractive shear stress at bank full flow.
4. The installation details and procedures shall be included on the site erosion and sediment control plan and will follow manufacturers specifications.



Construction Specifications

1. Prepare soil before installing matting by smoothing the surface, removing debris and large stone, and applying lime, fertilizer and seed. Refer to manufacturers installation details.
2. Begin at the top of the slope by anchoring the mat in a 6" deep x 6" wide trench. Backfill and compact the trench after stapling.
3. In channels or swales, begin at the downslope end, anchoring the mat at the bottom and top ends of the blanket. When another roll is needed, the upslope roll

should overlay the lower layer, shingle style, so that channel flows do not peel back the material.

4. Roll the mats down a slope with a minimum 4" overlap. Roll center mat in a channel in direction of water flow on bottom of the channel. Do not stretch blankets. Blankets shall have good continuous contact with the underlying soil throughout its entire length.
5. Place mats end over end (shingle style) with a 6" overlap, use a double row of staggered staples 4" apart to secure mats.
6. Full length edge of mats at top of side slopes must be anchored in 6" deep x 6" wide trench; backfill and compact the trench after stapling.
7. Mats on side slopes of a channel must be overlapped 4" over the center mat and stapled.
8. In high flow channel applications, a staple check slot is recommended at 30 to 40 foot intervals. Use a row of staples 4" apart over entire width of the channel. Place a second row 4" below the first row in a staggered pattern.
9. The terminal end of the mats must be anchored in a 6"x6" wide trench. Backfill and compact the trench after stapling.
10. Stapling and anchoring of blanket shall be done in accordance with the manufactures recommendations.

Maintenance

Blanketed areas shall be inspected weekly and after each runoff event until perennial vegetation is established to a minimum uniform 80% coverage throughout the blanketed area. Damaged or displaced blankets shall be restored or replaced within 2 calendar days.

STANDARD AND SPECIFICATIONS FOR ARMORED SLOPE AND CHANNEL STABILIZATION



Definition & Scope

A **permanent** layer of stone designed to protect and stabilize areas subject to erosion by protecting the soil surface from rain splash, sheet flow, rill and gully erosion and channel erosion. It can also be used to improve the stability of soil slopes that are subject to seepage or have poor soil structure.

Conditions Where Practice Applies

Riprap is used for cut and fill slopes subject to seepage, erosion, or weathering, particularly where conditions prohibit the establishment of vegetation. Riprap is also used for channel side slopes and bottoms, temporary dewatering diversion channels where the flow velocities exceed 6 feet/second, grade sills, on shorelines subject to erosion, and at inlets and outlets to culverts, bridges, slope drains, grade stabilization structures, and storm drains.

Slope Stabilization Design Criteria

Gradation – Riprap shall be a well-graded mixture with 50% by weight larger than the specified design size. The diameter of the largest stone size in such a mixture should be 1.5 times the d_{50} size with smaller sizes grading down to 1 inch. The designer should select the size or sizes that equal or exceed that minimum size based on riprap gradations commercially available in the area.

Thickness – The minimum layer thickness shall be 1.5 times the maximum stone diameter, but in no case less than 6 inches.

Quality – Stone for riprap shall be hard, durable field or quarry materials. They shall be angular and not subject to breaking down when exposed to water or weathering. The specific gravity shall be at least 2.5.

Size – The sizes of stones used for riprap protection are determined by purpose and specific site conditions:

1. Slope Stabilization – Riprap stone for slope stabilization not subject to flowing water or wave action shall be sized for the proposed grade. The gradient of the slope to be stabilized shall be less than the natural angle of repose of the stone selected. Angles of repose of riprap stones may be estimated from Figure 4.1.

Riprap used for surface stabilization of slopes does not add significant resistance to sliding or slope failure and should not be considered a retaining wall. Slopes approaching 1.5:1 may require special stability analysis. The inherent stability of the soil must be satisfactory before riprap is used for surface stabilization.

2. Channel Stabilization - Design criteria for sizing stone for stability of channel side slopes are presented under Channel Stabilization Design Criteria on page 4.10.
2. Outlet Protection – Design criteria for sizing stone and determining dimensions of riprap aprons are presented in Standards and Specifications for Rock Outlet Protection on page 3.39.

Filter Blanket – A filter blanket is a layer of material placed between the riprap and the underlying soil to prevent soil movement into or through the riprap. A suitable filter may consist of a well-graded gravel or sand-gravel layer or a synthetic filter fabric manufactured for this purpose. The design of a gravel filter blanket is based on the ratio of particle size in the overlying filter material to that of the base material in accordance with the criteria below. Multiple layers may be designed to affect a proper filter if necessary.

A gravel filter blanket should have the following relationship for a stable design:

$$\frac{d_{15} \text{ filter}}{d_{25} \text{ base}} \leq 5$$

$$5 < \frac{d_{15} \text{ filter}}{d_{50} \text{ base}} \leq 40$$

and

$$\frac{d_{20} \text{ filter}}{d_{20} \text{ base}} \leq 40$$

Filter refers to the overlying material while base refers to the underlying material. These relationships must hold between the base and filter and the filter and riprap to prevent migration of material. In some cases, more than one filter may be needed. Each filter layer should be a minimum of 6 inches thick, unless an acceptable filter fabric is used.

A synthetic filter fabric may be used with or in place of gravel filters. The following particle size relationships should exist:

1. Filter fabric covering a base containing 50% or less by weight of fine particles (#200 sieve size):

A.
$$\frac{d_{85} \text{ base (mm)}}{\text{EOS} \times \text{filter fabric (mm)}} > 1$$

- B. total open area of filter fabric should not exceed 36%

2. Filter fabric covering other soils:

- A. EOS is no larger than 0.21 mm (#70 sieve size)

- B. total open area of filter fabric should not exceed 10%

*EOS – Equivalent opening size compared to a U.S. standard sieve size.

No filter fabric should have less than 4% open area or an EOS less than U.S. Standard Sieve #100 (0.15 mm). The permeability of the fabric must be greater than that of the soil. The fabric may be made of woven or nonwoven monofilament yarns and should meet the following minimum requirements:

Thickness 20-60 mils

grab strength 90-120 lbs.

conform to ASTM D-1682 or ASTM D-177

Filter blankets should always be provided where seepage is significant or where flow velocity and duration of flow or turbulence may cause underlying soil particles to move through the riprap.

Construction Specifications

Subgrade Preparation – Prepare the subgrade for riprap and filter to the required lines and grades shown on the plans. Compact any fill required in the subgrade to a density approximating that of the undisturbed material or overfill depressions with riprap. Remove brush, trees, stumps, and other objectionable material. Cut the subgrade sufficiently deep so that the finished grade of the riprap will be at the

elevation of the surrounding area. Channels shall be excavated sufficiently to allow placement of the riprap in a manner such that the finished inside dimensions and grade of the riprap meet design specifications.

Sand and gravel filter blanket – Place the filter blanket immediately after the ground foundation is prepared. For gravel, spread filter stone in a uniform layer to the specified depth. Where more than one layer of filter material is used, spread the layers with minimal mixing.

Synthetic filter fabric – Place the cloth directly on the prepared foundation. Overlap the edges by at least 2 feet, and space the anchor pins every 3 feet along the overlap. Bury the upper and lower ends of the cloth a minimum of 12 inches below ground. Take precautions not to damage the cloth by dropping the riprap. If damage occurs, remove the riprap and repair the sheet by adding another layer of filter fabric with a minimum overlap of 12 inches around the damaged area. Where large stones are to be placed, a 4-inch layer of fine sand or gravel is recommended to protect the filter cloth. Filter fabric is not recommended as a filter on slopes steeper than 2 horizontal to 1 vertical.

Stone placement – Placement of the riprap shall follow immediately after placement of the filter. Place riprap so that it forms dense, well-graded mass of stone with a minimum of voids. The desired distribution of stones throughout the mass may be obtained by selective loading at the quarry and controlled dumping during final placement. Place riprap to its full thickness in one operation. Do not place riprap by dumping through chutes or other methods that cause segregation of stone sizes. Be careful not to dislodge the underlying base or filter when placing the stones.

The toe of the riprap shall be keyed into a stable foundation at its base as shown in Figure 4.2 - Typical Riprap Slope Protection Detail. The toe should be excavated to a depth of 2.0 feet. The design thickness of the riprap shall extend a minimum of 3 feet horizontally from the slope. The finished slope should be free of pockets of small stone or clusters of large stones. Hand placing may be necessary to achieve proper distribution of stone sizes to produce a relatively smooth, uniform surface. The finished grade of the riprap should blend with the surrounding area.

Maintenance

Riprap shall be inspected periodically for scour or dislodged stones. Control weed and brush growth as needed.

Figure 4.1
Angles of Repose of Riprap Stones (FHWA)

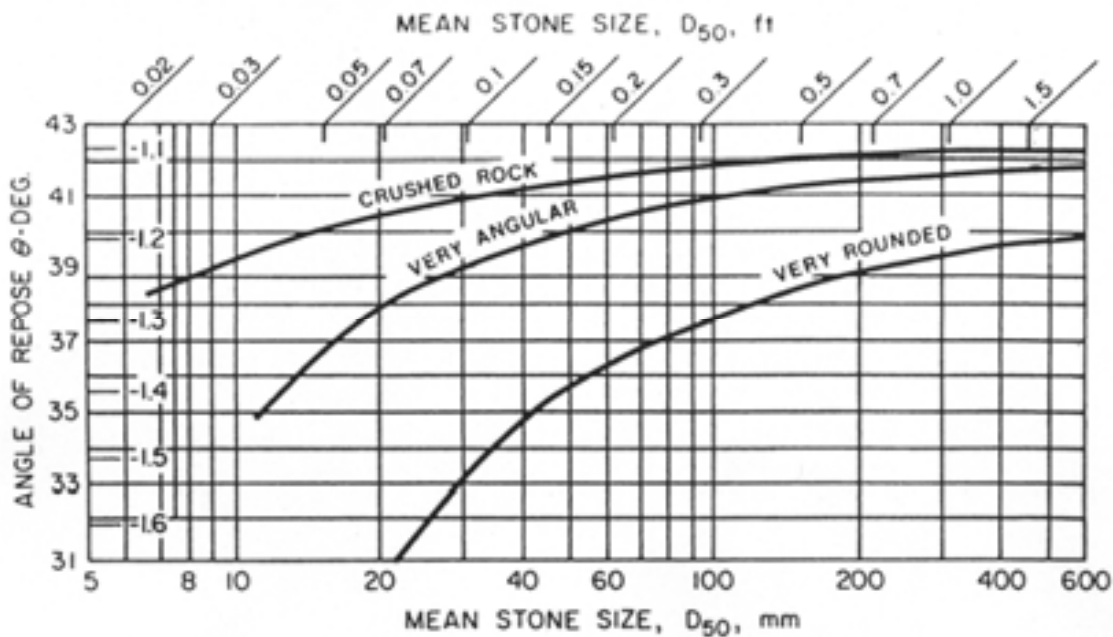
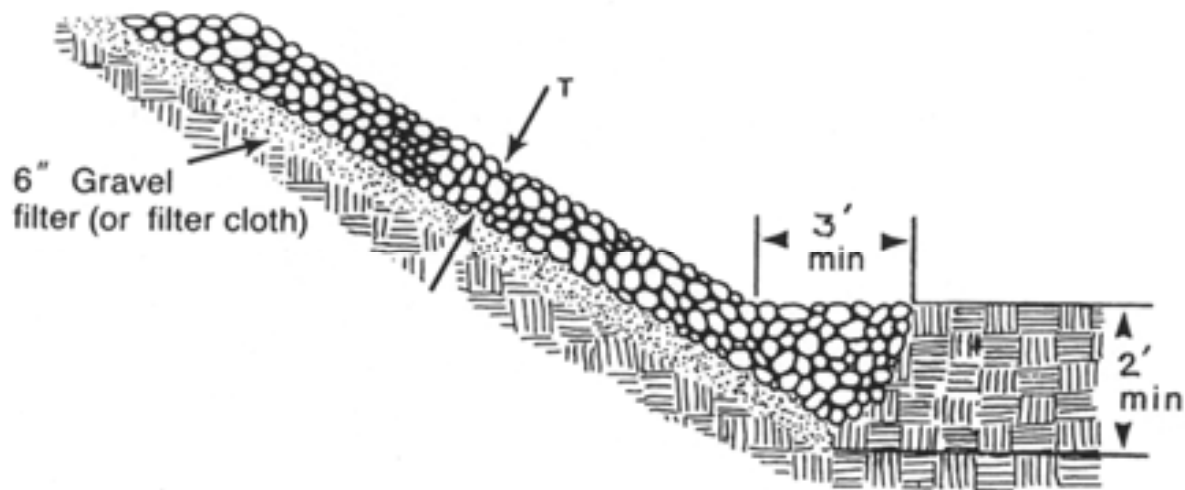


Figure 4.2
Typical Riprap Slope Protection Detail





Channel Stabilization Design Criteria

1. Since each channel is unique, measures for structural channel stabilization should be installed according to a design based on specific site conditions.
2. The plan and profile of the design reach should approximate a naturally stable channel from the project area, based on a stable “reference reach” for the subject channel type.
3. Develop designs according to the following principles:
 - Make protective measures compatible with other channel modifications planned or being carried out in the channel reaches.
 - Whenever excavation and re-shaping work is proposed within channels, the design should provide functional channel dimensions and geometry at each section. Work proposed within a stream channel may require permits from the NYS DEC and US Army Corps of Engineers.
 - Use the design velocity of the peak discharge of the 10-year storm or bankfull discharge, whichever is less. Structural measures should be capable of withstanding greater flows without serious damage.
 - Ensure that the channel bottom is stable or stabilized by structural means before installing any permanent slope protection.
 - Channel stabilization should begin at a stable location and end at a stable point along the bank.
 - Changes in alignment should not be done without a complete analysis of the environmental and stability effects on the entire system.
 - Provisions should be made to maintain and improve fish and wildlife habitat. For example, restoring lost vegetation will provide valuable shade, food, and/or cover.
 - Ensure that all requirements of state law and all permit requirements of local, state, and federal agencies are met.

Construction Specifications

Riprap – Riprap is the most commonly used material to structurally stabilize a channel. While riprap will provide the structural stabilization necessary, the side slope can be enhanced with vegetative material to slow the velocity of water, filter debris, and enhance habitat. See [Principles of Biotechnical Practices](#) on page 4.1, for more information.

1. Side slope – slopes shall be graded to 2:1 or flatter prior to placing bedding, filter fabric, or riprap.
2. Filter – filters should be placed between the base material and the riprap and meet the requirements of criteria listed pages 4.7 and 4.8.
3. Gradation – The gradation of the riprap is dependent on the velocity expected against the bank for the design conditions. See Table 4.1 on page 4.12. Once the velocity is known, gradation can be selected from the table for the appropriate class of rock. Note, this table was developed for a 2:1 slope; if the slope steepens to 1.5:1 the gradations should be increased 20%. The riprap should extend 2 feet below the channel bottom and be keyed into the side slope both at the upstream end and downstream end of the proposed work or reach.

See Figure 4.3 on page 4.13 for details.

Reinforced Concrete - Is often used to armor eroding sections of flow channel by constructing walls, bulk heads, or stabilize bank linings in urban areas for redevelopment work. Provide positive drainage behind these structures to relieve uplift pressures.



Grid Pavers – Modular concrete units with or without void areas can be used to stabilize flow channel. Units with void areas can allow the establishment of vegetation. These structures may be obtained in a variety of shapes (Figure 4.4) or they may be formed and poured in place. Maintain design and installation in accordance with manufacturer’s instructions.



Revetment – Structural support or armoring to protect an embankment from erosion. Riprap and gabions are commonly used. Also used is a hollow fabric mattress with cells that receive a concrete mixture. Any revetment should be installed to a depth below the anticipated channel degradation and into the channel bed as necessary to provide stability.



Modular Pre-Cast Units – Interlocking modular precast units of different sizes, shapes, heights, and depths, have been developed for a wide variety of applications. They provide vertical support in tight areas as well as durability. Many types are available with textured surfaces. They also act as gravity retaining walls. They should be designed and installed in accordance with the manufacturer’s recommendations (Figure 4.4). All areas disturbed by construction should be stabilized as soon as the structural measures are complete.



Maintenance

Check stabilized flow channel sections after every high-water event, and make any needed repairs immediately to prevent any further damage or unraveling of the existing work.

Table 4.1 - Riprap Gradations for Channel Stabilization

Class	Layer Thickness (in.)	Max. Velocity (ft/s)	Wave Height (ft.)	PERCENT FINER BY WEIGHT											
				D ₁₀			D ₅₀			D ₈₅			D ₁₀₀		
				Wt. (lbs.)	d _o (in.)	d _□ (in.)	Wt. (lbs.)	d _o (in.)	d _□ (in.)	Wt. (lbs.)	d _o (in.)	d _□ (in.)	Wt. (lbs.)	d _o (in.)	d _□ (in.)
I	18	8.5	-	5	5	4	50	10	8	100	13	10	150	15	12
II	18	10	-	17	7	6	170	15	12	340	19	15	500	22	18
III	24	12	2	46	10	8	460	21	17	920	26	21	1400	30	24
IV	36	14	3	150	15	12	1500	30	25	3000	39	32	4500	47	36
V	48	17	4.8	370	20	16	3700	42	34	7400	53	43	11,000	60	49

d_o = gravel material d_□ = angular rock riprap
 Wt = weight in pounds

**Figure 4.3
Riprap Channel Stabilization**

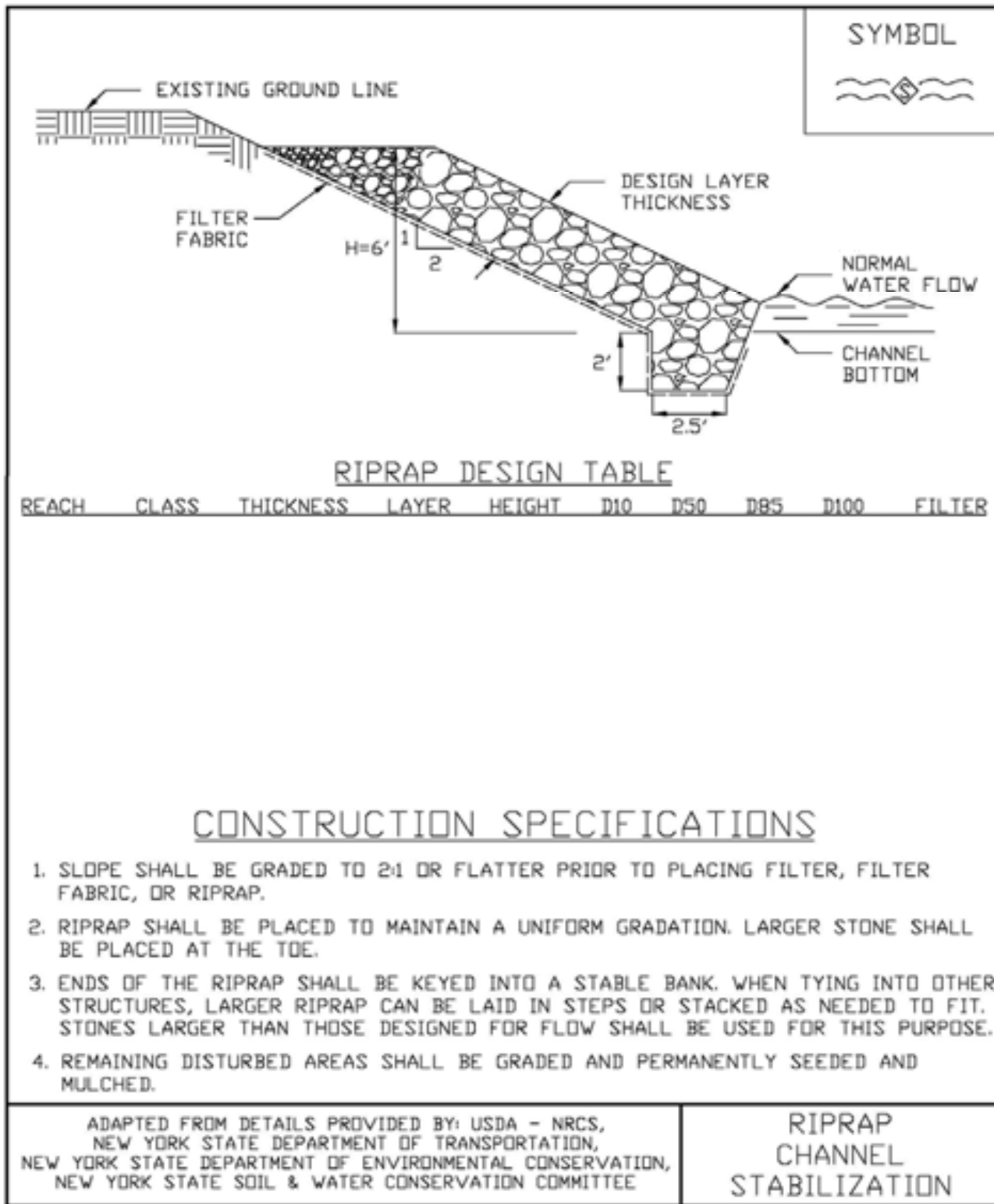
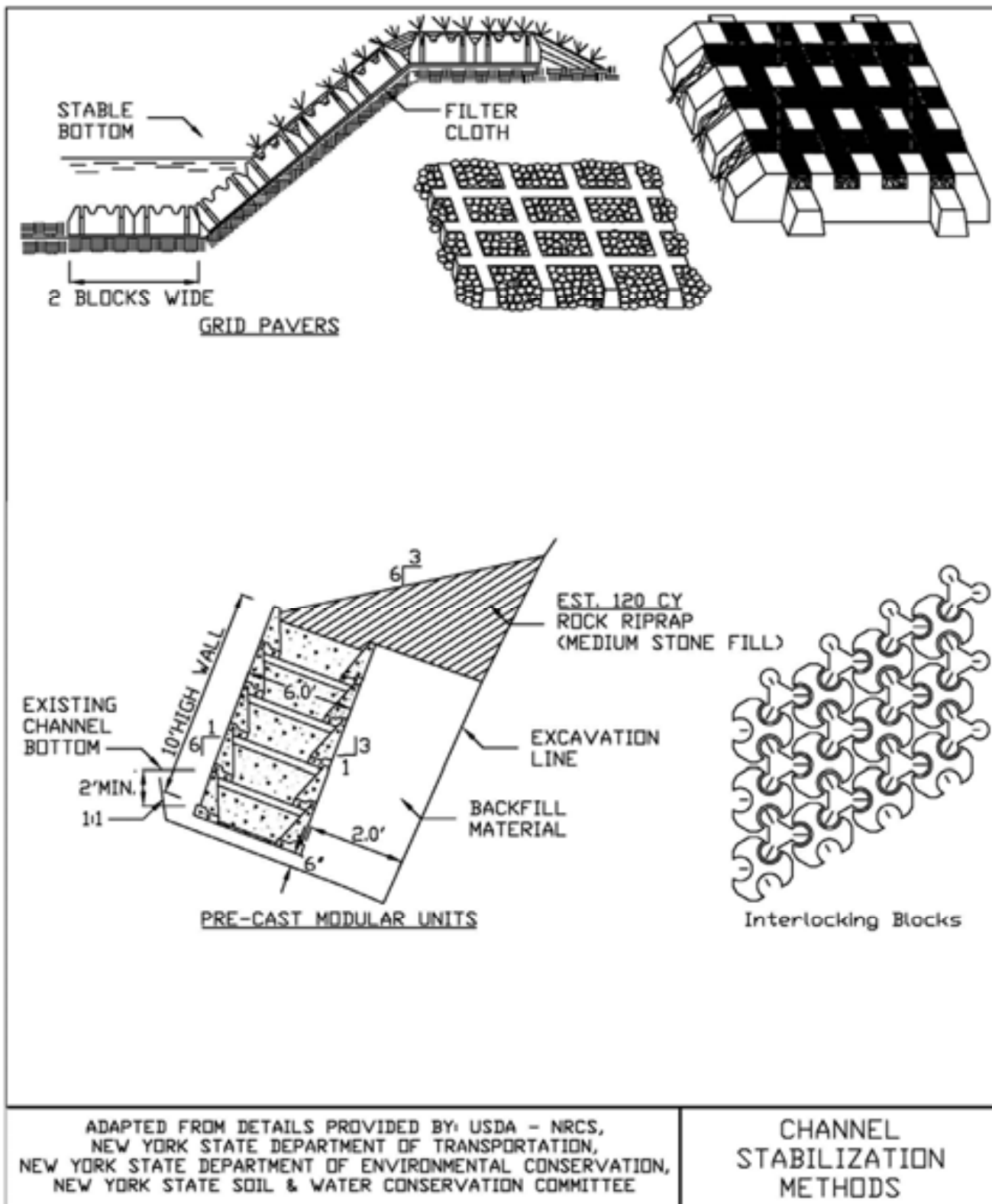


Figure 4.4
Channel Stabilization Methods



STANDARD AND SPECIFICATIONS FOR BRANCHPACKING



Maintenance

Due to the susceptibility of plant materials to the physical constraints of the site, climate conditions, and animal populations, it is necessary to inspect installations frequently. This is especially important during the first year or two of establishment. Plant materials missing or damaged should be replaced as soon as possible. Sloughs or breaks in drainage pattern should be reestablished for the site as quickly as possible to maintain stability.

Definition & Scope

Branchpacking consists of alternate layers of live branch cuttings and tamped backfill to repair small, localized slumps and holes in slopes to provide repair to existing slopes that have small slips or slumps by filling in the failed area with plant materials and soil.

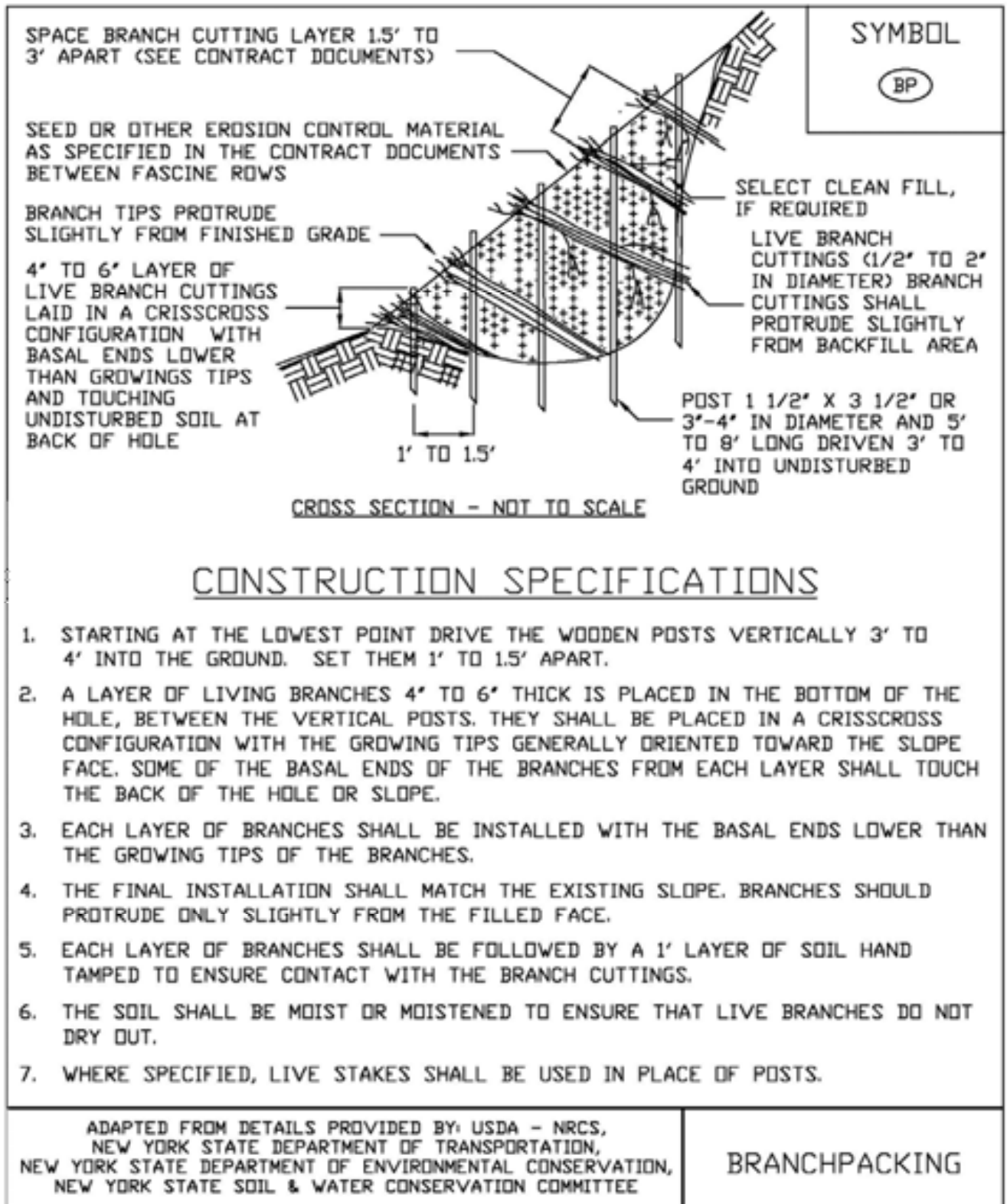
Conditions Where Practice Applies

This is an appropriate technique for repairing slip areas that do not exceed 4 feet deep or 6 feet wide. It should not be used as a slope stability measure if structural embankment support is needed.

Design Criteria

1. The live branch cuttings shall be 1/2 - 2 inches in diameter and long enough to touch the undisturbed soil at the back of the area to be repaired. They should extend 4 - 6 inches beyond the finished backfill grade.
2. Wooden posts should be used to secure the plant material in place. They should be 6 - 8 feet long and 3 - 4 inches in diameter. If lumber is used, it shall be a minimum standard two by four.
3. Wooden posts shall be driven vertically 3 feet deep and placed in a grid pattern 1 - 2 feet apart.
4. Beginning at the bottom of the slip area, 4 - 6 inch layers of live branch cuttings are placed in angled layers, 1.5 to 3 feet apart. Compacted moist soil is placed between the layers (see Figure 4.5).
5. Seasonal planting restriction may have to be considered.

**Figure 4.5
Branchpacking**



STANDARD AND SPECIFICATIONS FOR BRUSH LAYER



enough to contact the back of the bench with the growing tips protruding out of the slope face.

Care shall be taken not to severely damage the live branch cuttings during installation. Damaged cuttings will be replaced prior to backfilling.

Starting at the toe of the slope, excavate benches along the contour of the slope. The benches shall range from 2 to 3 feet wide and the surface of the bench shall be angled so the front edge is higher than the back of the bench (See Figure 4.6). The benches shall be spaced according to the previous table, Slope Distance Between Layers (ft).

Live branch cuttings shall be placed on the bench in a crisscross or overlapping configuration in layers 3 - 4 inches thick at the butt ends. Backfill shall be placed on top of the live branch cuttings and tamped in 6 inch lifts. Small plate compactors may be used to settle the soil. Areas between the rows of brush layers shall be stabilized by seeding or other appropriate erosion control method.

Definition & Scope

A brush layer is a horizontal row of live branch cuttings placed in soil with other similar rows, spaced a specific vertical distance apart to stabilize cut and fill slope areas by reinforcing the soil with uprooted branch stems, trapping debris on slope, drying excessively wet sites, and redirecting adverse slope seepage by acting as horizontal drains.

Conditions Where Practice Applies

Generally applicable to stabilize slope areas above the flow line of streambanks as well as cut and fill slopes. Brush layers can be used on slopes up to 2:1 in steepness and 20 feet in height.

Design Criteria

The spacing requirements for brush layer rows is dependent on the slope steepness and moisture content. Spacing shall conform with the following table.

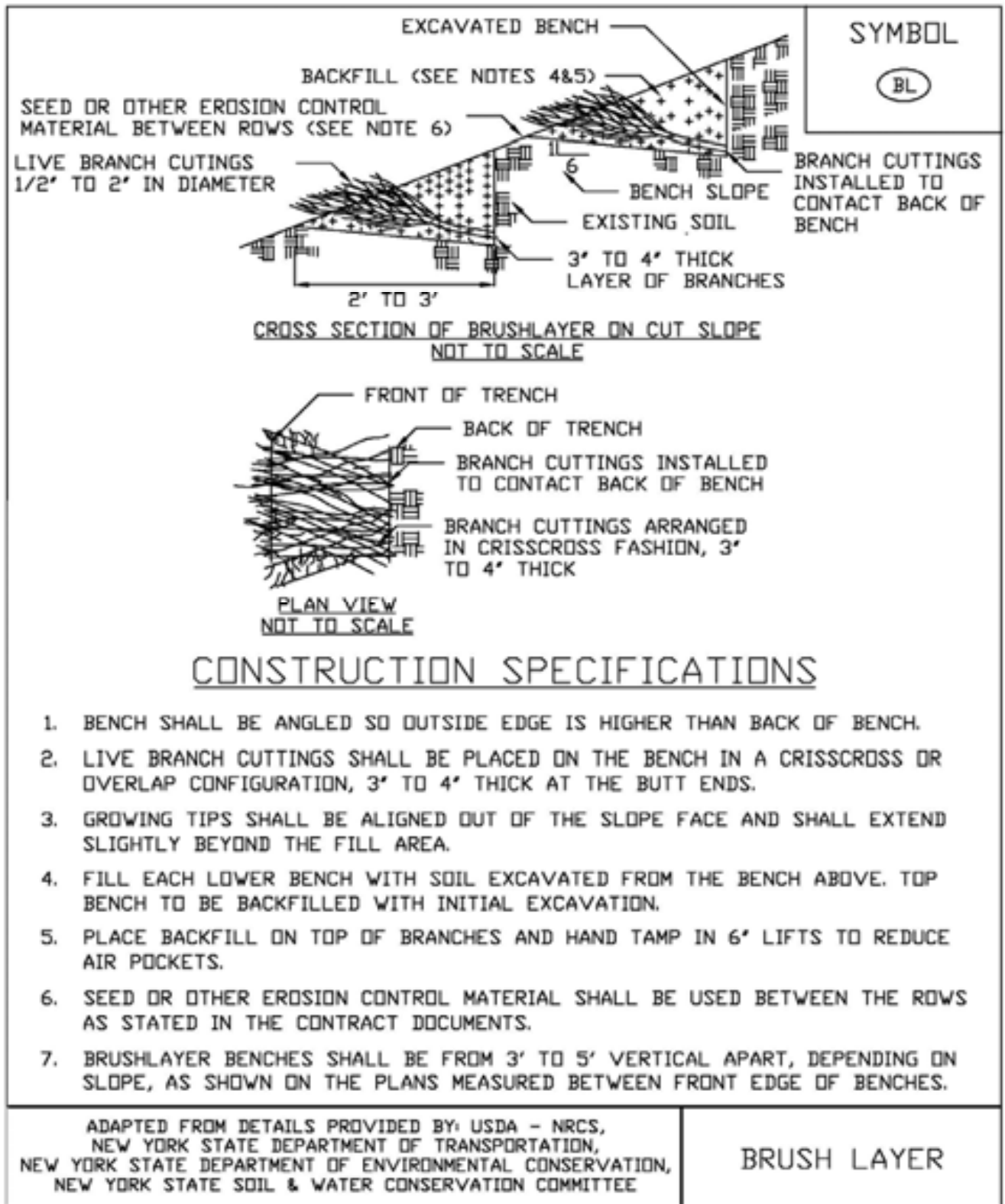
Slope Distance Between Layers (feet)			
Slope H : V	Wet Slope	Dry Slope	Max Slope Length
2 to 2.5:1	3'	3'	15'
2.5 to 3.5:1	3'	4'	15'
3.5 to 4.0:1	4'	5'	25'

Brush layer cuttings shall be 1/2 to 2 inches in diameter and be from dormant plants. No leaf buds shall have initiated growth beyond 1/4" and the cambium layer shall be moist, green, and healthy. The cuttings shall be long

Maintenance

Due to the susceptibility of plant materials to the physical constraints of the site, climate conditions, and animal populations, it is necessary to inspect installations frequently. This is especially important during the first year or two of establishment. Plant materials missing or damaged should be replaced as soon as possible. Sloughs or breaks in drainage pattern should be reestablished for the site as quickly as possible to maintain stability. The brush layer may need to be watered periodically during the first year if installation is done during the summer months.

**Figure 4.6
Brush Layer**



STANDARD AND SPECIFICATIONS FOR BRUSH MATTRESS



Definition & Scope

A mulch or mattress of living brush laid on a slope and fastened down with stakes and wire to protect the soil surface on slopes from erosive forces through the generation of a dense stand of woody vegetation.

Conditions Where Practice Applies

Brush mattresses are used primarily on streambanks where the velocity is less than 6 feet per second and excessive streamflow has created erosive conditions. This practice can resist temporary inundation, but not scour or undercutting.

Design Criteria

Layer Thickness—The brush shall be a minimum of 3 inches thick (excluding top soil layer).

Height—The mattress shall be placed up the bank to the bankfull elevation. The toe of the mattress should be located in a fascine trench.

Slope—The maximum slope shall be 1.5:1.

Anchoring—The mattress shall be anchored on the slope by a grid of 3-foot stakes driven on 3-foot centers each way. No. 9 wire is then wound between the stakes, which are driven to secure the mattress. The upstream edge of the mattress should be keyed into the bank 2 feet.

Materials—The plant materials should be willow or dogwood brush placed as shown in Figure 4.7.

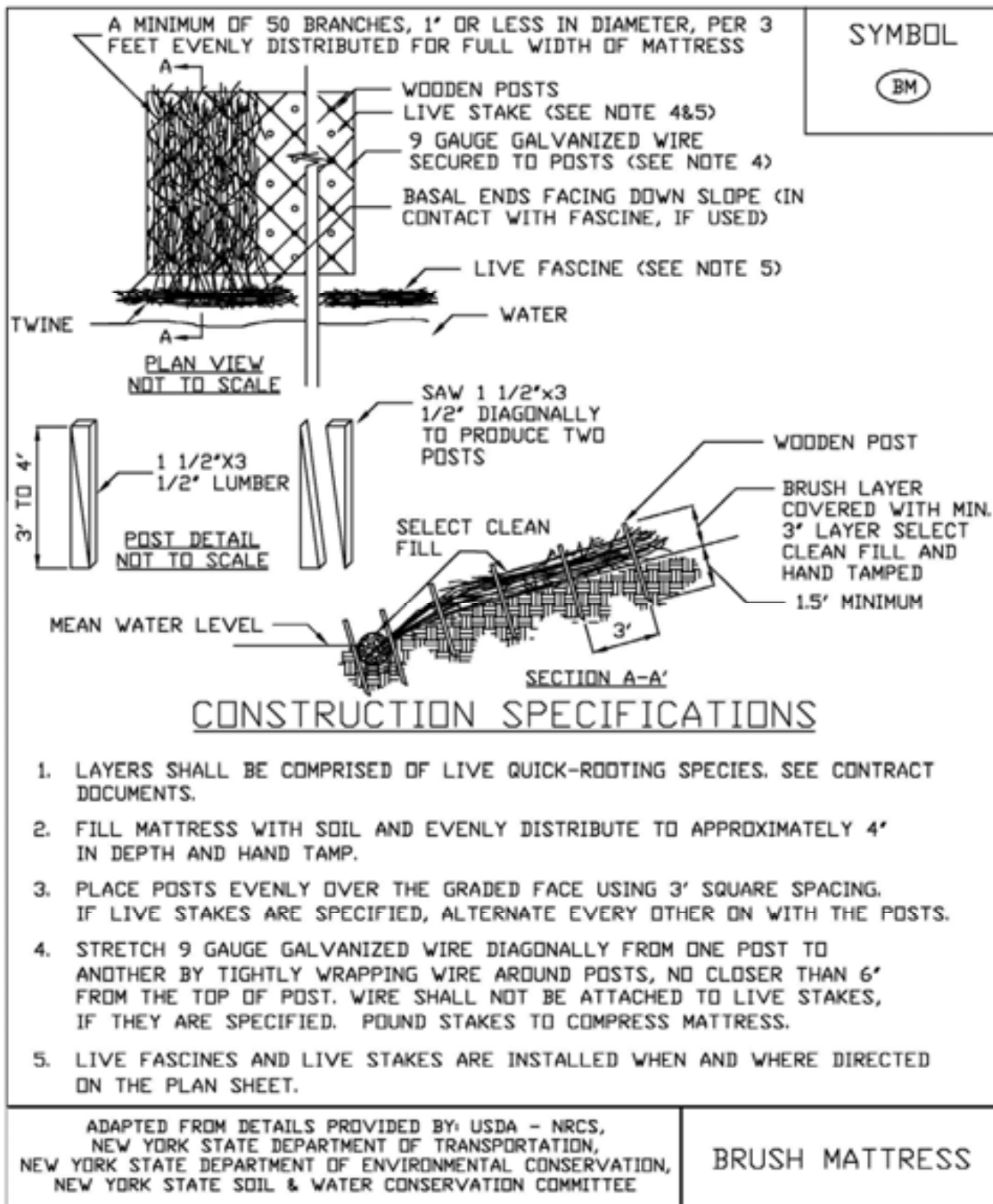
Construction Specifications

1. Prepare slope surface by grading to a uniform, smooth surface, clear of obstruction. Slopes should be graded before the brush mattress is installed.
2. The fascine toe should be installed first. Then lay brush beginning at the downstream end of the work. The toe below the waterline may be anchored by rock.
3. The butt end of the brush will be placed upstream and plant materials inclined approximately 30 degrees.
4. The upstream edge of the mattress will be keyed into the slope 2 feet. Stakes will be driven throughout the mattress on 3-foot centers each way beginning along the toe of the mattress.
5. No. 9 wire will be attached to the stakes and tightened to secure the mattress.
6. Slope areas above the mattress will be shaped and seeded.

Maintenance

Scheduled inspections the first year are necessary to make sure the anchoring system is sound. Broken wire or missing stakes shall be replaced immediately. Any missing toe material shall be replaced. The brush mattress may need to be watered periodically during the first year if installation is done during the summer months.

**Figure 4.7
Brush Mattress**



STANDARD AND SPECIFICATIONS FOR FERTILIZER APPLICATION



Definition & Scope

The **permanent** incorporation of fertilizer into the planting zone of the soil profile to provide nutrient amendments to the soil for vigorous support to plant and vegetation growth.

Conditions Where Practice Applies

This standard applies to all areas where permanent seeding, sodding, and plant establishment is required. All application of fertilizer shall be in accordance with Nutrient Runoff Law - ECL Article 17, Title 21. Phosphorus runoff poses a threat to water quality. Therefore, under New York Law, fertilizer containing phosphorus may only be applied to lawn or non-agricultural turf when:

1. A soil test indicates that additional phosphorus is needed for growth of that lawn or non-agricultural turf, or
2. The fertilizer is used for newly established lawn or non-agricultural turf during the first growing season.

For projects located within watersheds where enhanced phosphorus removal standards are required as part of its post-construction stormwater management plan, use of any fertilizer containing more than 0.67 percent phosphate (P_2O_5) content will be done only with a valid soil test demonstrating the need for that formulation.

Design Criteria

Fertilizer is sold with an analysis printed on the tag or bag shown as three numbers separated by a dash, such as 5-10-5. The first number is the percent of the total weight of the bag that is nitrogen (N), the second is the percent of

phosphate (phosphorus, P), and the third is the percent of potash (potassium, K). Other elements are sometimes included and are listed with these three basic components.

For example a 40 lb bag of 5-10-5 fertilizer contains 5% of 40 lbs of Nitrogen which equals 2 lbs. There is 10% of 40 lbs of phosphate (phosphorus) which equals 4 lbs, and there is 5% of potash (potassium), another 2 lbs., for a total of 8 lbs of active fertilizer in the 40 lb bag. The rest is filler to aid in spreading the material over the area to be treated.

Specify the design fertilizer mix and application rates based on the results of the soil tests.

Specifications

1. In no case shall fertilizer be applied between December 1 and April 1 annually.
2. Fertilizer shall not be spread within 20 feet of a surface water.
3. Any fertilizer falling or spilled into impervious surface areas such as parking lots, roadways, and sidewalks should be immediately contained and legally applied or placed in an appropriate container.
4. Incorporate the fertilizer, and lime if specified, into the top 2-4 inches of the topsoil or soil profile.
5. When applying fertilizer by hydro seeding care should be taken to apply mix only to seed bed areas at an appropriate flow rate to prevent erosion and spraying onto impervious areas.



STANDARD AND SPECIFICATIONS FOR FIBER ROLL



Definition & Scope

A fiber roll is a coir (coconut fiber), straw, or excelsior roll encased in netting of jute, nylon, or burlap to dissipate energy along streambanks, channels, and bodies of water and to reduce sheet flow on slopes.

Conditions Where Practice Applies

Fiber rolls are used where the water surface levels are relatively constant. Artificially controlled streams for hydropower are not good candidates for this technique. The rolls provide a good medium for the introduction of herbaceous vegetation. Planting in the fiber roll is appropriate where the roll will remain continuously wet.

Design Criteria

1. The roll is placed in a shallow trench dug below baseflow or in a 4 inch trench on the slope contour and anchored by 2" x 2", 3-foot long posts driven on each side of the roll (see Figure 4.8).
2. The roll is contained by a 9-gauge non-galvanized wire placed over the roll from post to post. Braided nylon rope (1/8" thick) may be used.
3. The anchor posts shall be spaced laterally 4 feet on center on both sides of the roll and driven down to the top of the roll.
4. Soil is placed behind the roll and planted with suitable herbaceous or woody vegetation. If the roll will be continuously saturated, wetland plants may be planted into voids created in the upper surface of the roll.
5. Where water levels may fall below the bottom edge of the roll, a brush layer of willow should be installed so

as to lay across the top edge of the roll.

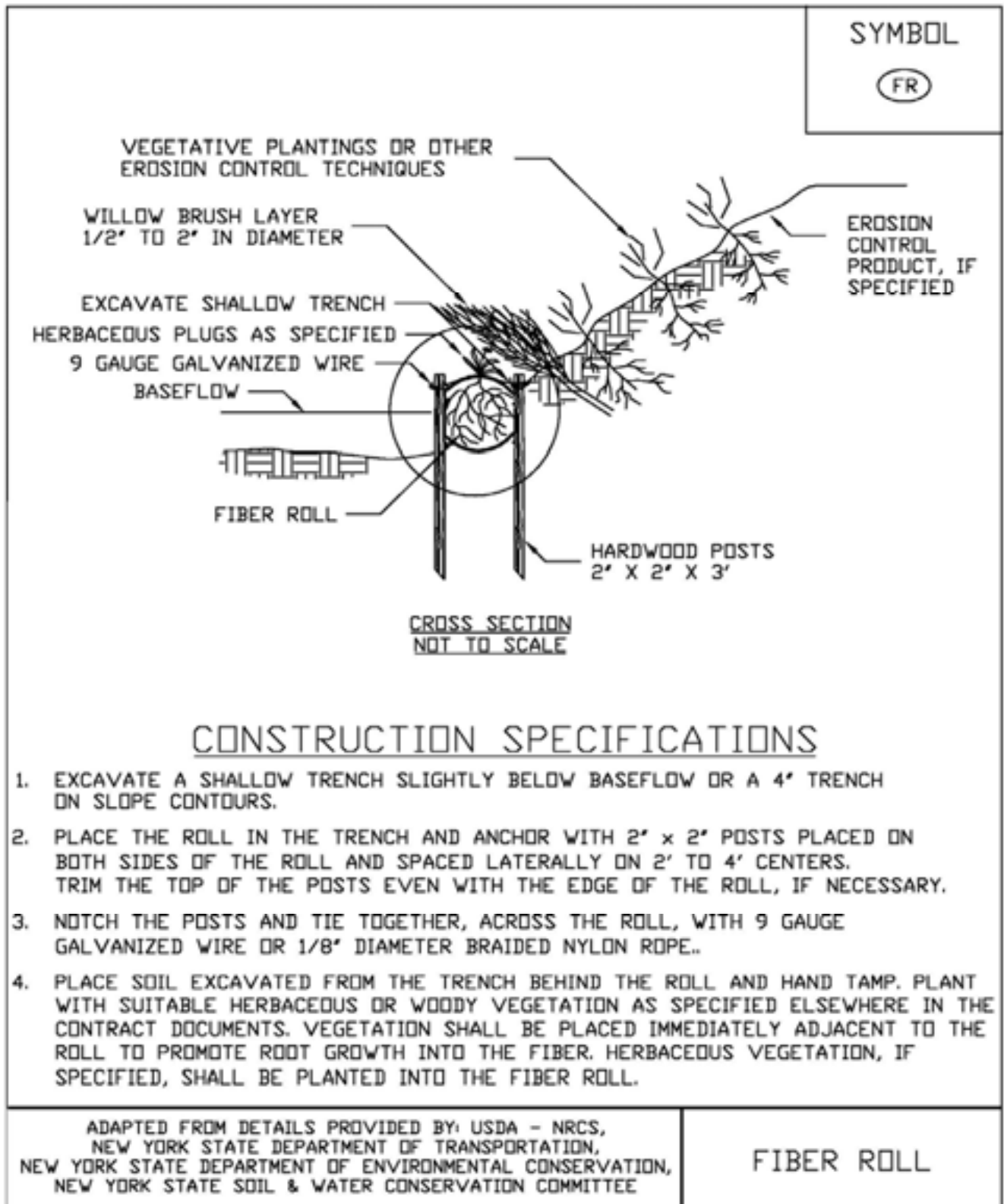
6. Where fiber rolls are used to reduce sheet flow on slopes they should be at least 12" in diameter and spaced according to the straw bale dike standard for sediment control.

Maintenance

Due to the susceptibility of plant materials to the physical constraints of the site, climate conditions, and animal populations, it is necessary to inspect installations frequently. This is especially important during the first year or two of establishment. Plant materials missing or damaged should be replaced as soon as possible. Sloughs or breaks in drainage pattern should be reestablished for the site as quickly as possible to maintain stability.



**Figure 4.8
Fiber Roll**



STANDARD AND SPECIFICATIONS FOR LANDGRADING



Definition & Scope

Permanent reshaping of the existing land surface by grading in accordance with an engineering topographic plan and specification to provide for erosion control and vegetative establishment on disturbed, reshaped areas.

Design Criteria

The grading plan should be based upon the incorporation of building designs and street layouts that fit and utilize existing topography and desirable natural surrounding to avoid extreme grade modifications. Information submitted must provide sufficient topographic surveys and soil investigations to determine limitations that must be imposed on the grading operation related to slope stability, effect on adjacent properties and drainage patterns, measures for drainage and water removal, and vegetative treatment, etc.

Many municipalities and counties have regulations and design procedures already established for land grading and cut and fill slopes. Where these requirements exist, they shall be followed.

The plan must show existing and proposed contours of the area(s) to be graded. The plan shall also include practices for erosion control, slope stabilization, safe disposal of runoff water and drainage, such as waterways, lined ditches, reverse slope benches (include grade and cross section), grade stabilization structures, retaining walls, and surface and subsurface drains. The plan shall also include phasing of these practices. The following shall be incorporated into the plan:

1. Provisions shall be made to safely convey surface runoff to storm drains, protected outlets, or to stable water courses to ensure that surface runoff will not

damage slopes or other graded areas; see standards and specifications for Grassed Waterway, Diversion, or Grade Stabilization Structure.

2. Cut and fill slopes that are to be stabilized with grasses shall not be steeper than 2:1. When slopes exceed 2:1, special design and stabilization consideration are required and shall be adequately shown on the plans. (Note: Where the slope is to be mowed, the slope should be no steeper than 3:1, although 4:1 is preferred because of safety factors related to mowing steep slopes.)
3. Reverse slope benches or diversion shall be provided whenever the vertical interval (height) of any 2:1 slope exceeds 20 feet; for 3:1 slope it shall be increased to 30 feet and for 4:1 to 40 feet. Benches shall be located to divide the slope face as equally as possible and shall convey the water to a stable outlet. Soils, seeps, rock outcrops, etc., shall also be taken into consideration when designing benches.
 - A. Benches shall be a minimum of six feet wide to provide for ease of maintenance.
 - B. Benches shall be designed with a reverse slope of 6:1 or flatter to the toe of the upper slope and with a minimum of one foot in depth. Bench gradient to the outlet shall be between 2 percent and 3 percent, unless accompanied by appropriate design and computations.
 - C. The flow length within a bench shall not exceed 800 feet unless accompanied by appropriate design and computations; see Standard and Specifications for Diversion on page 3.9
4. Surface water shall be diverted from the face of all cut and/or fill slopes by the use of diversions, ditches and swales or conveyed downslope by the use of a designed structure, except where:
 - A. The face of the slope is or shall be stabilized and the face of all graded slopes shall be protected from surface runoff until they are stabilized.
 - B. The face of the slope shall not be subject to any concentrated flows of surface water such as from natural drainage ways, graded ditches, downspouts, etc.
 - C. The face of the slope will be protected by anchored stabilization matting, sod, gravel, riprap, or other stabilization method.

5. Cut slopes occurring in ripable rock shall be serrated as shown in Figure 4.9 on page 4.26. The serrations shall be made with conventional equipment as the excavation is made. Each step or serration shall be constructed on the contour and will have steps cut at nominal two-foot intervals with nominal three-foot horizontal shelves. These steps will vary depending on the slope ratio or the cut slope. The nominal slope line is 1 ½: 1. These steps will weather and act to hold moisture, lime, fertilizer, and seed thus producing a much quicker and longer-lived vegetative cover and better slope stabilization. Overland flow shall be diverted from the top of all serrated cut slopes and carried to a suitable outlet.
6. Subsurface drainage shall be provided where necessary to intercept seepage that would otherwise adversely affect slope stability or create excessively wet site conditions.
7. Slopes shall not be created so close to property lines as to endanger adjoining properties without adequately protecting such properties against sedimentation, erosion, slippage, settlement, subsidence, or other related damages.
8. Fill material shall be free of brush, rubbish, rocks, logs, stumps, building debris, and other objectionable material. It should be free of stones over two (2) inches in diameter where compacted by hand or mechanical tampers or over eight (8) inches in diameter where compacted by rollers or other equipment. Frozen material shall not be placed in the fill nor shall the fill material be placed on a frozen foundation.
9. Stockpiles, borrow areas, and spoil shall be shown on the plans and shall be subject to the provisions of this Standard and Specifications.
10. All disturbed areas shall be stabilized structurally or vegetatively in compliance with the Permanent Construction Area Planting Standard on page 4.42.
4. Areas to be filled shall be cleared, grubbed, and stripped of topsoil to remove trees, vegetation, roots, or other objectionable material.
5. Areas that are to be topsoiled shall be scarified to a minimum depth of four inches prior to placement of topsoil.
6. All fills shall be compacted as required to reduce erosion, slippage, settlement, subsidence, or other related problems. Fill intended to support buildings, structures, and conduits, etc., shall be compacted in accordance with local requirements or codes.
7. All fill shall be placed and compacted in layers not to exceed 9 inches in thickness.
8. Except for approved landfills or nonstructural fills, fill material shall be free of frozen particles, brush, roots, sod, or other foreign objectionable materials that would interfere with, or prevent, construction of satisfactory fills.
9. Frozen material or soft, mucky or highly compressible materials shall not be incorporated into fill slopes or structural fills.
10. Fill shall not be placed on saturated or frozen surfaces.
11. All benches shall be kept free of sediment during all phases of development.
12. Seeps or springs encountered during construction shall be handled in accordance with the Standard and Specification for Subsurface Drain on page 3.48 or other approved methods.
13. All graded areas shall be permanently stabilized immediately following finished grading.
14. Stockpiles, borrow areas, and spoil areas shall be shown on the plans and shall be subject to the provisions of this Standard and Specifications.

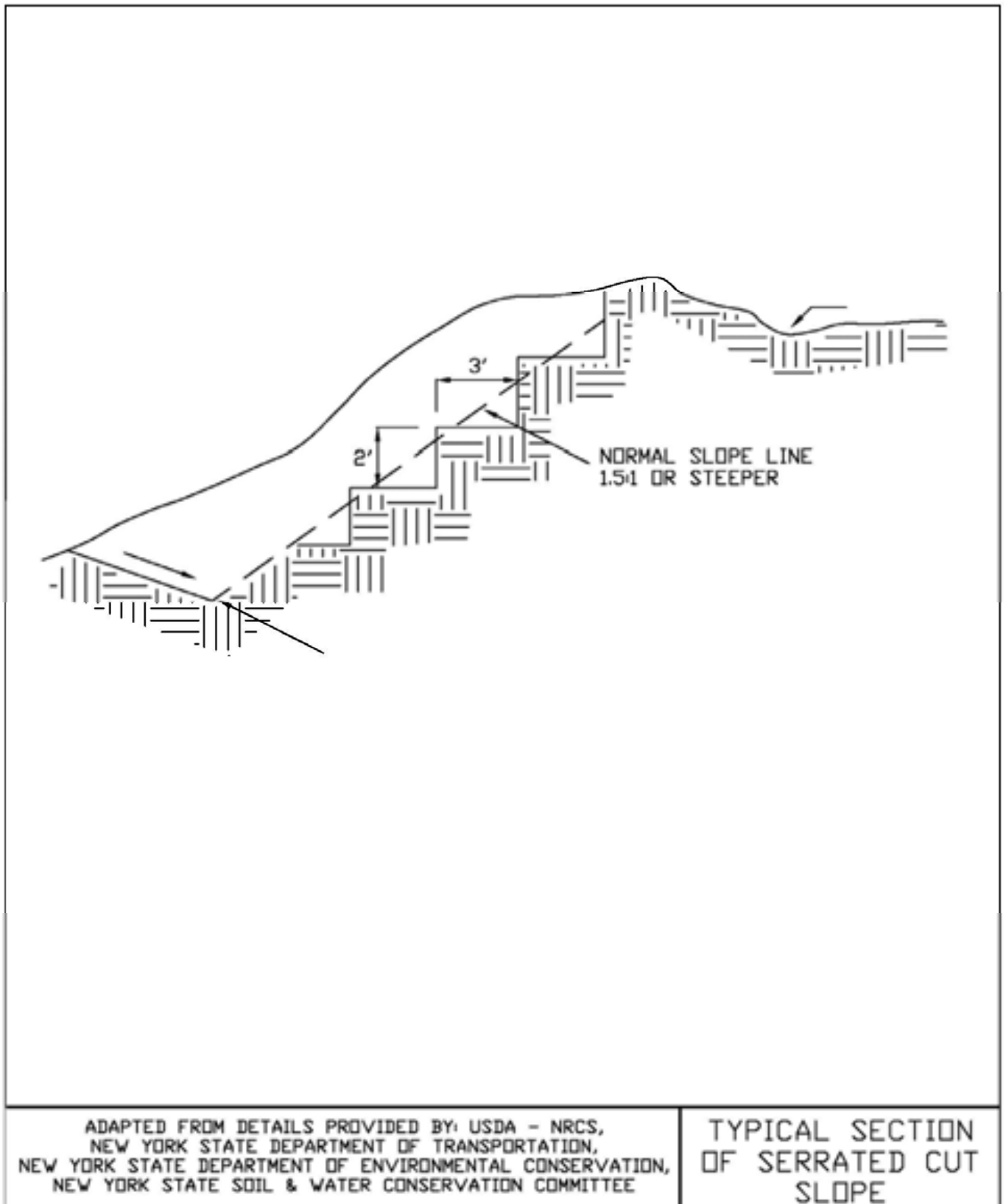
Construction Specifications

See Figures 4.9 and 4.10 for details.

1. All graded or disturbed areas, including slopes, shall be protected during clearing and construction in accordance with the erosion and sediment control plan until they are adequately stabilized.
2. All erosion and sediment control practices and measures shall be constructed, applied and maintained in accordance with the erosion and sediment control plan and these standards.
3. Topsoil required for the establishment of vegetation shall be stockpiled in amount necessary to complete finished grading of all exposed areas.



Figure 4.9
Typical Section of Serrated Cut Slope



**Figure 4.10
Landgrading**

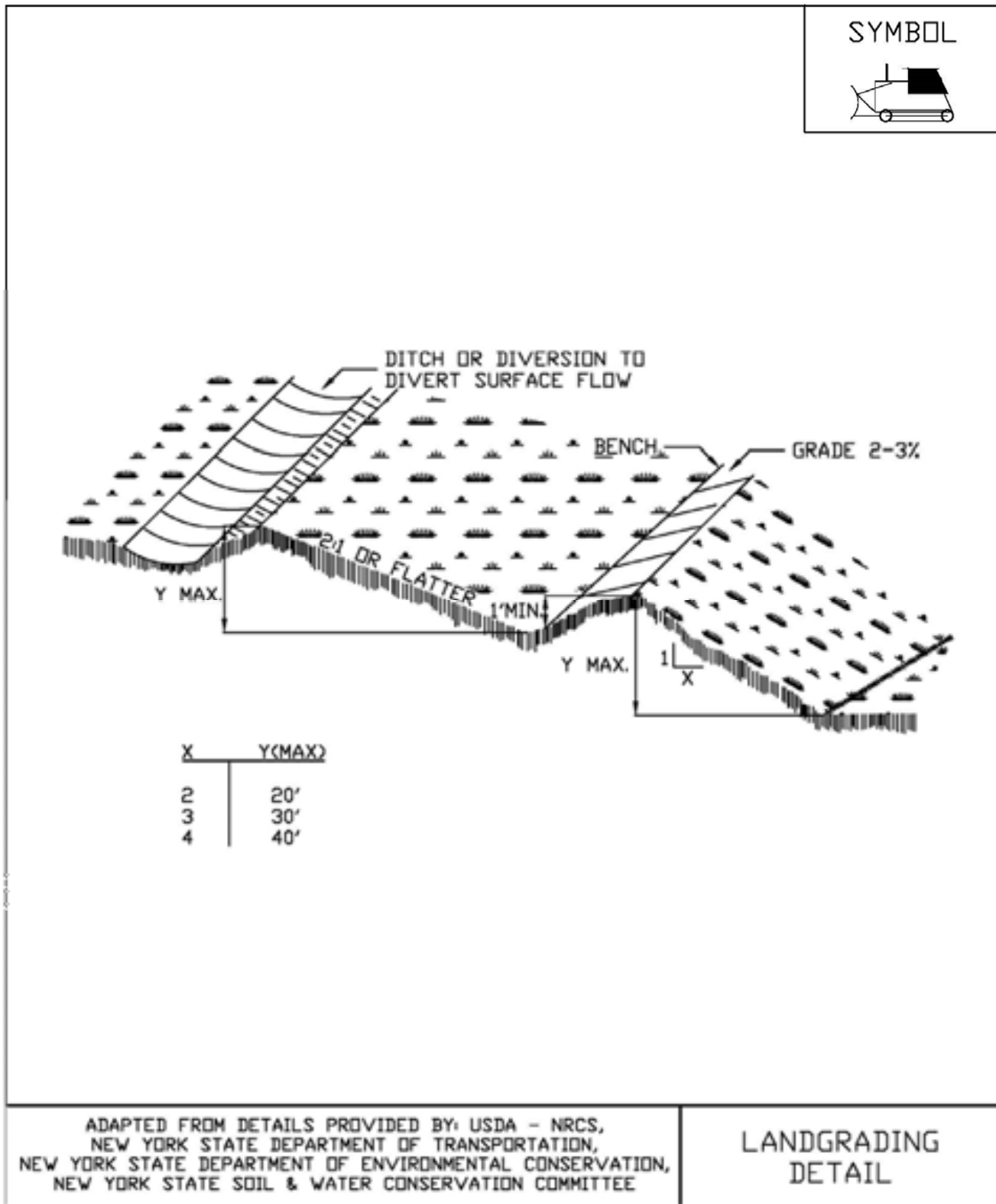


Figure 4.11
Landgrading - Construction Specifications

<u>CONSTRUCTION SPECIFICATIONS</u>	
<ol style="list-style-type: none"> 1. ALL GRADED OR DISTURBED AREAS INCLUDING SLOPES SHALL BE PROTECTED DURING CLEARING AND CONSTRUCTION IN ACCORDANCE WITH THE APPROVED EROSION AND SEDIMENT CONTROL PLAN UNTIL THEY ARE PERMANENTLY STABILIZED. 2. ALL SEDIMENT CONTROL PRACTICES AND MEASURES SHALL BE CONSTRUCTED, APPLIED AND MAINTAINED IN ACCORDANCE WITH THE APPROVED EROSION AND SEDIMENT CONTROL PLAN. 3. TOPSOIL REQUIRED FOR THE ESTABLISHMENT OF VEGETATION SHALL BE STOCKPILED IN AMOUNT NECESSARY TO COMPLETE FINISHED GRADING OF ALL EXPOSED AREAS. 4. AREAS TO BE FILLED SHALL BE CLEARED, GRUBBED, AND STRIPPED OF TOPSOIL TO REMOVE TREES, VEGETATION, ROOTS OR OTHER OBJECTIONABLE MATERIAL. 5. AREAS WHICH ARE TO BE TOPSOILED SHALL BE SCARIFIED TO A MINIMUM DEPTH OF FOUR INCHES PRIOR TO PLACEMENT OF TOPSOIL. 6. ALL FILLS SHALL BE COMPACTED AS REQUIRED TO REDUCE EROSION, SLIPPAGE, SETTLEMENT, SUBSIDENCE OR OTHER RELATED PROBLEMS. FILL INTENDED TO SUPPORT BUILDINGS, STRUCTURES AND CONDUITS, ETC. SHALL BE COMPACTED IN ACCORDANCE WITH LOCAL REQUIREMENTS OR CODES. 7. ALL FILL SHALL BE PLACED AND COMPACTED IN LAYERS NOT TO EXCEED 9 INCHES IN THICKNESS. 8. EXCEPT FOR APPROVED LANDFILLS, FILL MATERIAL SHALL BE FREE OF FROZEN PARTICLES, BRUSH, ROOTS, SOD, OR OTHER FOREIGN OR OTHER OBJECTIONABLE MATERIALS THAT WOULD INTERFERE WITH OR PREVENT CONSTRUCTION OF SATISFACTORY FILLS. 9. FROZEN MATERIALS OR SOFT, MUCKY OR HIGHLY COMPRESSIBLE MATERIALS SHALL NOT BE INCORPORATED IN FILLS. 10. FILL SHALL NOT BE PLACED ON SATURATED OR FROZEN SURFACES. 11. ALL BENCHES SHALL BE KEPT FREE OF SEDIMENT DURING ALL PHASES OF DEVELOPMENT. 12. SEEPS OR SPRINGS ENCOUNTERED DURING CONSTRUCTION SHALL BE HANDLED IN ACCORDANCE WITH THE STANDARD AND SPECIFICATION FOR SUBSURFACE DRAIN OR OTHER APPROVED METHOD. 13. ALL GRADED AREAS SHALL BE PERMANENTLY STABILIZED IMMEDIATELY FOLLOWING FINISHED GRADING. 14. STOCKPILES, BORROW AREAS AND SPOIL AREAS SHALL BE SHOWN ON THE PLANS AND SHALL BE SUBJECT TO THE PROVISIONS OF THIS STANDARD AND SPECIFICATION. 	
ADAPTED FROM DETAILS PROVIDED BY: USDA - NRCS, NEW YORK STATE DEPARTMENT OF TRANSPORTATION, NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION, NEW YORK STATE SOIL & WATER CONSERVATION COMMITTEE	LANDGRADING SPECIFICATIONS

STANDARD AND SPECIFICATIONS FOR LIME APPLICATION



The amount of limestone needed can be estimated by using the following table. A soil test is the only way to determine the soil pH. This table is very general, but it is useful for planning.

General lime guidelines (at 100% ENV)

Initial Soil pH	Sands	Sandy Loams	Loam and Silt Loams	Silty Clay Loams
4.5	2.5	6.0	9.5	13.0
4.6-4.7	2.5	6.0	9.0	12.5
4.8-4.9	2.5	5.5	8.5	12.0
5.0-5.1	2.0	5.0	7.5	10.5
5.2-5.3	1.5	4.0	6.5	8.5
5.4-5.5	1.0	3.0	4.0	6.0
5.6-5.7	1.0	2.0	3.0	4.5
5.8-5.9	0.7	1.5	2.5	3.5
6.0-6.1	0.6	1.5	2.0	3.0
6.2-6.3	0.4	1.0	1.5	2.0
6.4-6.5	0.3	0.7	1.0	1.5
6.6-6.7	0.2	0.5	0.7	1.0

Lime guidelines are in tons per acre and are based on a plow depth of 8.0 inches. Correct rate if plowing to a different depth.

Conversion for small areas: 1 ton/acre = 2,000#/43,560 ft², 46#/1,000 ft²

Definition & Scope

Permanent incorporation of agricultural ground limestone within the top 2 to 6 inches of the soil profile to increase the soil pH from an acidic level to a neutral level to provide an active growth medium for vegetation.

Conditions Where Practice Applies

At all locations where a vigorous growth of vegetation is desired and the soil pH is less than 7.0 or neutral.

Design Criteria

Liming material sold in New York varies considerably in several ways. The mineral content (calcium and magnesium) of the limestone may be high or low and, the fineness or particle sizes vary between suppliers. Two types of limestone are sold. The most common is limestone high in calcium. Dolomitic limestone contains magnesium (Mg) and calcium (Ca). Limestone sold in NY varies from 0 to 20% Mg while the calcium content of lime varies from 14.7% to 51.5%. Particle size determines how rapidly the calcium and magnesium will react with the acid in the soil. The finer the particle sizes, the quicker the reaction.

When obtaining agricultural limestone, one should state on the specification that the amount should be adjusted to 100% **effective neutralizing value (ENV)**. This is the way to compare materials as it adjusts for the reactive Ca and Mg and the particle size. The ENV is stated as the ratio needed to convert a limestone recommendation to 100% ENV. Thus, if the recommendation is 4 tons/acre of 100% ENV lime and the lime being used had an 80% ENV (1/ENV = 1.25), 4 times 1.25 or 5 tons/acre would be required.

Note: Lime should not be applied within 50 feet of streams and wetlands.

STANDARD AND SPECIFICATIONS FOR LIVE CRIB WALL



Definition & Scope

A hollow box-like structure made with an interlocking arrangement of untreated logs or timber members spiked together and anchored into the slope. The structure is filled with suitable earthfill materials and layers of live branch cuttings which root inside the structure and extend into the slope. This protects exposed or eroded streambanks from the erosive forces of flowing water and stabilize the toe of slope to reduce slope steepness.

Conditions Where Practice Applies

Generally applicable where flows are less than 6 feet per second and no degradation of the streambed occurs. Can reduce steepness and provide stability where space is limited and a vertical structure is needed. It is not intended to be used where the integrity of a road or structure is dependent on the cribwall since it is not designed to resist large lateral earth pressures.

Design Criteria

1. The vegetated cribwall structure shall be designed to a height for its intended purpose.
2. Live branch cuttings should be 1/2 to 2 inches in diameter and long enough to reach from the front of the structure to the undisturbed soil.
3. The structure will be built with a batter of 1 to 12. Large spikes or rebar are required to secure the logs or timbers together (10 inches minimum).
4. Only untreated logs or timber shall be used in the cribwall.
5. Installation begins with excavating to a stable

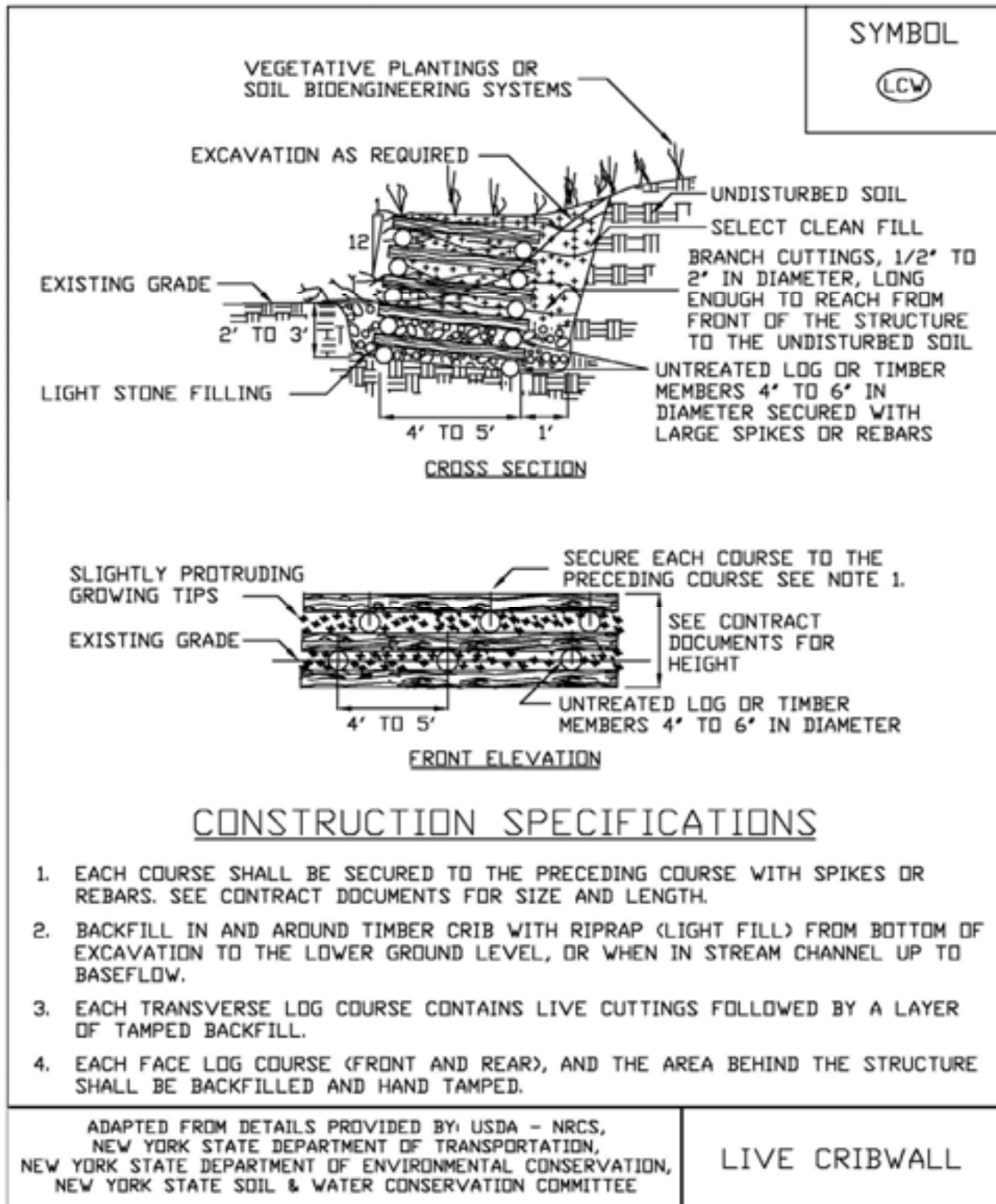
foundation 2' - 3' below the ground elevation at the toe of slope with the back of the excavation (to the slope) slightly deeper than the front.

6. The first course of logs is placed along the front and back of the excavated foundation approximately 4-5 feet apart and parallel to the slope contour.
7. The next course is placed at right angles on top of the previous course to overhang the front and back of the previous logs by 3-6 inches.
8. Each course is placed in the same manner and fastened to the preceding course to the desired grade.
9. Stone fill is placed in the bottom of the structure up to the ground level and up to the base flow in a stream channel.
10. Once the cribwall structure reaches the existing ground elevation, live branch cuttings are placed on the stone fill parallel with the slope contour.
11. The cuttings are then covered with select clean fill with a maximum size of 3 inches and not more than 20 percent passing a 200 sieve size.
12. The live branch cuttings shall be placed at each course followed by the select fill to the top of the structure with the growing tips slightly protruding from the cribwall face.
13. The plant materials shall be kept in a healthy growing condition by watering. Also see maintenance below.

Maintenance

Due to the susceptibility of plant materials to the physical constraints of the site, climate conditions, and animal populations, it is necessary to inspect installations frequently. This is especially important during the first year or two of establishment. Plant materials missing or damaged should be replaced as soon as possible. Sloughs or breaks in drainage pattern should be reestablished for the site as quickly as possible to maintain stability. Plant materials may need to be watered periodically during the first growing season if installed during summer months.

Figure 4.12
Live Cribwall



STANDARD AND SPECIFICATIONS FOR LIVE FASCINES



Slope	Contour Interval
1:1	3'
1.5:1	3'
2:1	4'
2.5:1	4'
3:1	5'
3.5:1	5'
4:1	6'
6:1	8'

Definition & Scope

The placement of groups or bundles of twigs, whips, or branches in shallow trenches, on the contour, on either cut or fill slopes. To stabilize slopes by slowing water movement down the slope, increasing infiltration, trapping slope sediments, and increasing soil stability with root systems.

Conditions Where Practice Applies

On sloping areas such as road cuts, slumped areas, road fills, gullies, and streambanks subject to erosion, seepage, or weathering, which have a low to medium hazard potential should slope failure occur. Slopes must be 1:1 or flatter.

Design Criteria

Materials—Shall be a native or nursery grown cultivar that is capable of performing the intended function.

Fascines—Shall be made by forming the bundles 8-15 feet long, 4 inches minimum in diameter, from stems no more than 1 inch in diameter.

Overlap—Fascines should be overlapped at the tapered ends a minimum of 1-foot.

Vertical Spacing—The spacing of the contours for the fascines is dependent on the degree of erosion or potential erosion at the site. Factors include slope steepness, soil type, drainage, and existing ground cover. The following is a general guide to selecting contour interval:

See Figure 4.13 for details.

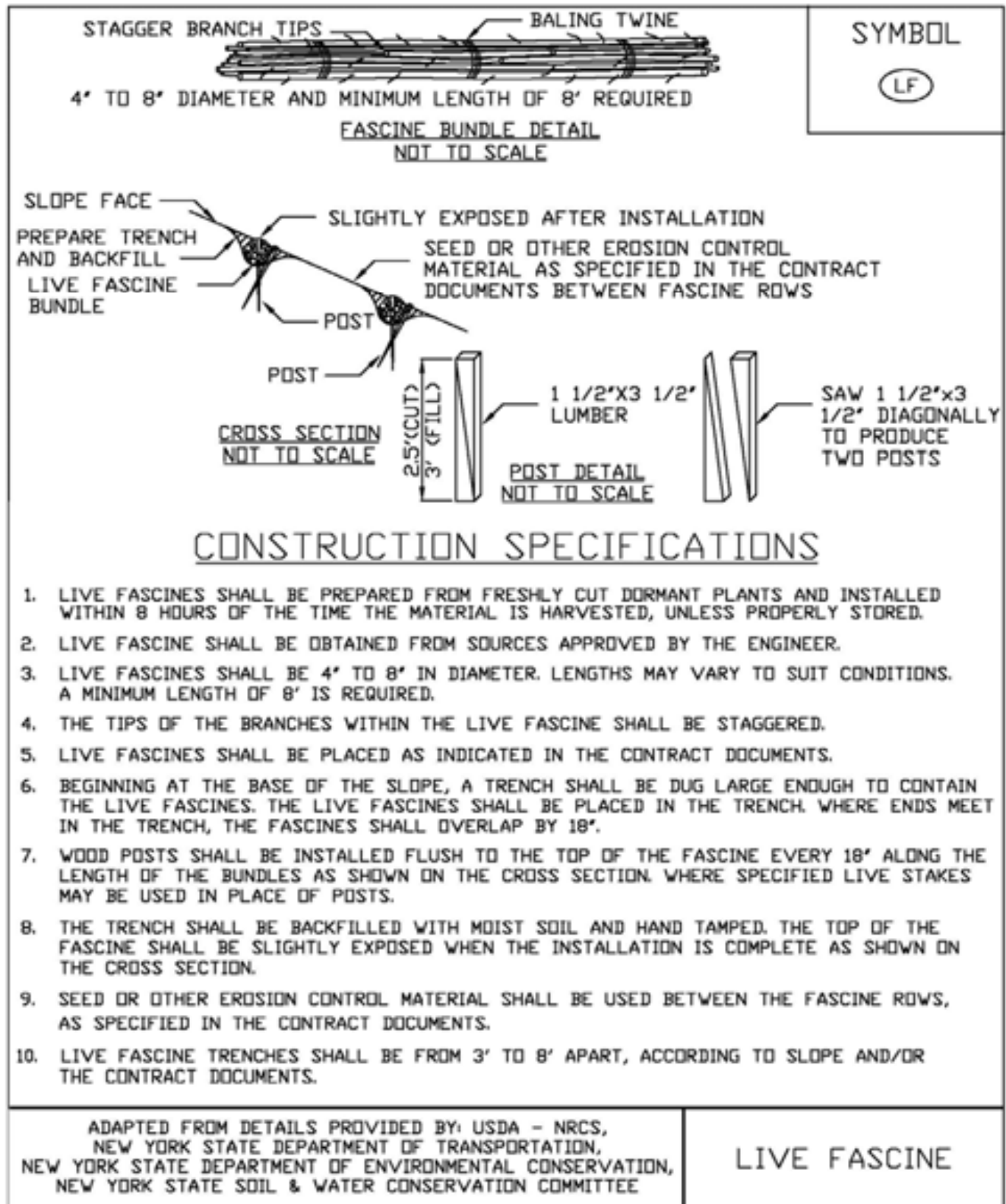
Construction Specifications

1. Fascines shall be 4 inches minimum in diameter.
2. Prior to placing the fascines, the slope shall be smoothed and graded with obstructions removed. Any structural measures for revetment, drainage, or surface water management will be installed first.
3. Working from the bottom of the slope to the top, excavate the fascine trench. Place fascines in trench and anchor with stakes spaced at 24 inches. Cover fascines with soil leaving about 10% exposed to view. Fascines shall be overlapped 12 inches minimum in the trench.
4. Soil shall be worked into the fascine and compacted by walking on the fascine being covered.
5. All disturbed areas should be seeded upon completion of fascine placement.

Maintenance

Regular inspection and maintenance of fascine installations should be conducted especially during the first year of establishment. Loose stakes should be reset and settled fill areas should be brought back to grade. Prompt corrections to gullies, sloughs or other evident problems shall be made.

Figure 4.13
Live Fascine



STANDARD AND SPECIFICATIONS FOR LIVE STAKES



Definition & Scope

A stake or pole fashioned from live woody material to create a living root mat that stabilizes the soil by reinforcing and binding soil particles together and by contributing to the reduction of excess soil moisture.

Conditions Where Practice Applies

Live stakes are an appropriate technique for repair of small earth slips and slumps that are frequently wet and for stabilizing raw streambanks. This technique is for relatively uncomplicated site conditions when construction time is limited and an inexpensive vegetative method for stabilization is derived. It is not intended where structural integrity is required nor to resist large, lateral earth pressures.

Design Criteria

1. Live stakes shall be 1 - 2 inches in diameter and 2-6 feet long, depending on site application.
2. No leaf buds shall have initiated growth beyond 1/4" and the cambium layer shall be moist, green and healthy.
3. All material shall be maintained in a continuously cool, covered, and moist state prior to use and be in good condition when installed.
4. Materials harvested on site shall be installed the same day they are prepared. Nursery grown material shall be maintained in a moist condition until installed.
5. Installation Details
 - A. The lengths of live cuttings/live stakes depends upon the application. If through riprap, the length

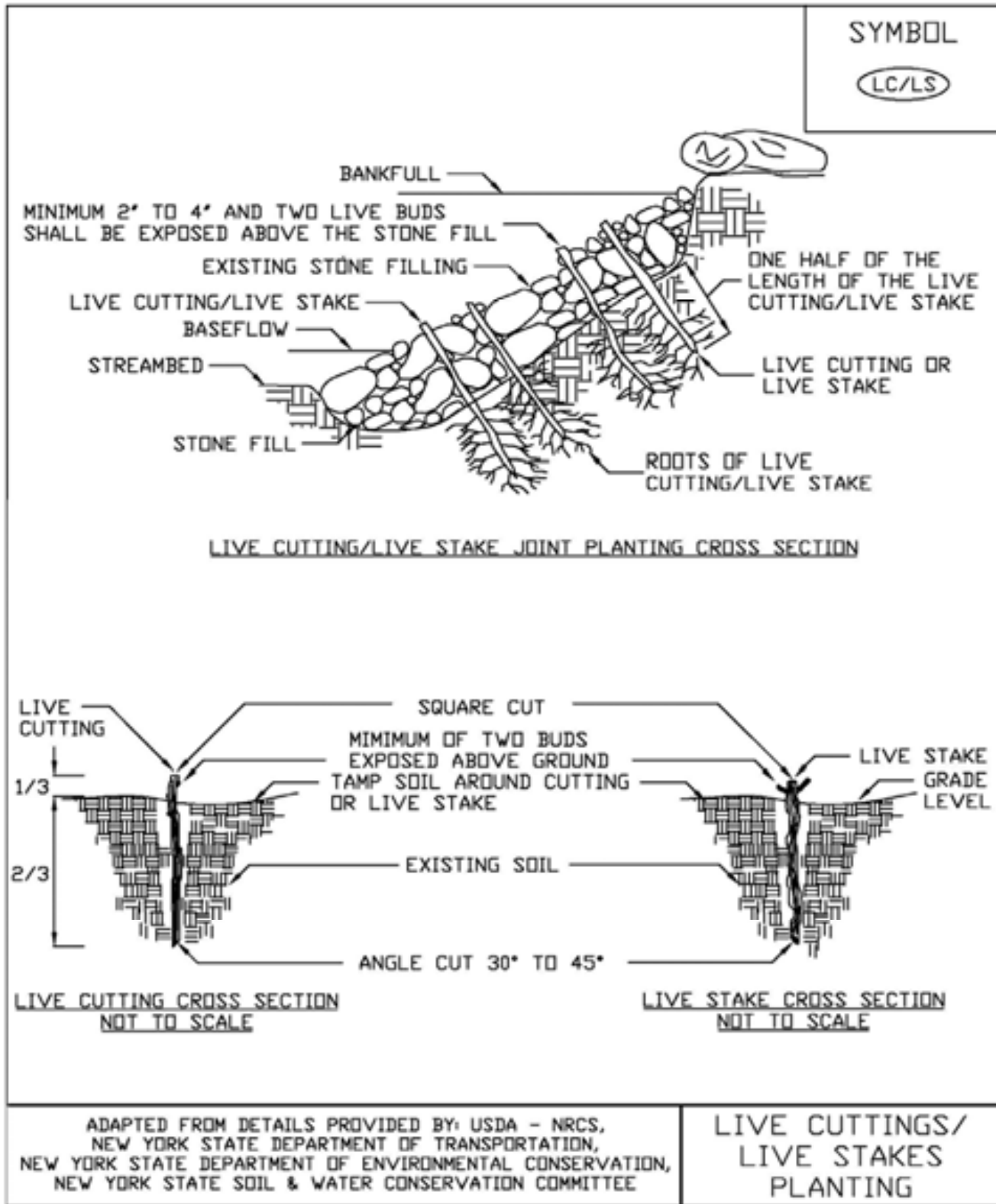
shall extend through the surface of the stone fill. At least half the length shall be inserted into the soil, below the stone fill. Spacing along the waterline is usually 1 foot.

- B. Minimum 2 to 4 inches and two live buds of the live stake shall be exposed above the stone filling.
- C. Live stakes shall be cut to a point on the basal end for insertion in the ground.
- D. Use a dead blow hammer to drive stakes into the ground. The hammer head should be filled with shot or sand. A dibble, iron bar, or similar tool shall be used to make a pilot hole to prevent damaging the material during installation.
- E. Live cuttings shall be inserted by hand into pilot holes.
- F. When possible, tamp soil around live stakes.
- G. Care shall be taken not to damage the live stakes during installation. Those damaged at the top during installation shall be trimmed back to undamaged condition.

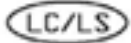
Maintenance

Due to the susceptibility of plant materials to the physical constraints of the site, climate conditions, and animal populations, it is necessary to inspect installations frequently. This is especially important during the first year or two of establishment. Plant materials missing or damaged should be replaced as soon as possible. Sloughs or breaks in drainage pattern should be reestablished for the site as quickly as possible to maintain stability. Plant materials may need to be watered periodically during the first growing season if installed during summer months.

Figure 4.14
Live Stake



**Figure 4.15
Live Stake Construction Specifications**

		SYMBOL 
CONSTRUCTION SPECIFICATIONS		
<ol style="list-style-type: none"> 1. CARE SHALL BE TAKEN NOT TO DAMAGE THE LIVE CUTTINGS/LIVE STAKES DURING INSTALLATION. THOSE DAMAGED SHALL BE LEFT IN PLACE AND SUPPLEMENTED WITH AN INTACT LIVE CUTTING/LIVE STAKE. 2. THE LENGTHS OF LIVE CUTTINGS/LIVE STAKES DEPENDS UPON THE APPLICATION. THE LENGTH SHALL EXTEND THROUGH THE SURFACE OF THE STONE FILL. AT LEAST HALF THE LENGTH SHALL BE INSERTED IN TO THE SOIL, BELOW THE STONE FILL. 3. A PILOT HOLE IS REQUIRED TO ENSURE THAT THE LIVE CUTTING/LIVE STAKE IS NOT DAMAGED WHEN DRIVEN THROUGH THE STONE FILLING. ACCESS SHALL BE MADE THROUGH THE USE OF A DIBBLE BAR, OR SIMILAR TOOL TO WORK AN OPENING THROUGH THE ROCK LAYER. 4. MINIMUM 2' TO 4' AND TWO LIVE BUDS OF THE LIVE CUTTING/LIVE STAKE SHALL BE EXPOSED ABOVE THE STONE FILLING. 5. LIVE CUTTINGS SHALL RANGE FROM 1/2' TO 1' IN DIAMETER AND BE FROM 1' TO 4' IN LENGTH. 6. LIVE STAKES SHALL RANGE FROM 1' TO 4' IN DIAMETER AND BE FROM 5' TO 6' IN LENGTH. 7. SEE CONTRACT DOCUMENTS FOR SPECIES, SIZE, SPACING, LOCATION, AND FINAL DETERMINATION ON USE OF CUTTINGS OR STAKES. 8. LIVE CUTTINGS/LIVE STAKES SHALL BE CUT TO A POINT ON THE BASAL END FOR INSERTION IN THE GROUND. 9. USE A DEAD BLOW HAMMER TO DRIVE STAKES INTO THE GROUND. (HAMMER HEAD FILLED WITH SHOT OR SAND.) A DIBBLE, IRON BAR, OR SIMILAR TOOL SHALL BE USED TO MAKE A PILOT HOLE TO PREVENT DAMAGING THE MATERIAL DURING INSTALLATION. 10. LIVE CUTTINGS SHALL BE INSERTED BY HAND INTO PILOT HOLES. 11. WHEN POSSIBLE, TAMP SOIL AROUND LIVE CUTTING/LIVE STAKES. 		
ADAPTED FROM DETAILS PROVIDED BY: USDA - NRCS, NEW YORK STATE DEPARTMENT OF TRANSPORTATION, NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION, NEW YORK STATE SOIL & WATER CONSERVATION COMMITTEE		LIVE CUTTINGS/ LIVE STAKES PLANTING SPECS

STANDARD AND SPECIFICATIONS FOR LOOSE STABILIZATION BLANKETS



Definition and Scope

Blankets of various materials placed pneumatically, hydraulically, or other means on a prepared planting area or a critical area where existing vegetation can remain to reduce rain splash and sheet erosion and promote vegetative stabilization.

Conditions Where Practice Applies

Loose blankets are an appropriate stabilization practice for any soil surface that is rocky, frozen, flat, or steep. They can be used on streambanks, road cuts and embankments, and construction site areas where stormwater runoff occurs as sheet flow. They should not be used in areas of concentrated flow.

Design Criteria

Compost Blanket

Material: The compost infill shall be well decomposed (matured at least 3 months), weed-free, organic matter. It shall be aerobically composted, possess no objectionable odors, and contain less than 1%, by dry weight, of man-made foreign matter. The physical parameters of the compost shall meet the standards listed in Table 5.2 - Compost Standards Table. **Note: All biosolids composts produced in New York State (or approved for importation) must meet NYS DEC's 6 NYCRR Part 360 (Soild Waste Management Facilities) requirements. The Part 360 requirements are equal to or more stringent than 40 CFR Part 503 which ensure safe standards for pathogen reduction and heavy metal content. When using compost blankets adjacent to surface waters, the compost should have a low nutrient value.**

Placement: The method of application and depth of compost depend upon site conditions. Vegetation of the compost blanket is generally archived by incorporating seed into the compost before it is applied. However, seeding may occur after the application if needed.

The compost application rate will be in accordance with the following table. Compost is not recommended for slopes steeper than 2H:1V. Slopes with problem soils and more runoff will require greater application rates.

Compost Application Rates		
Slope Length (ft)	<3H:1V Slopes	3H:1V to 2H:1V Slopes
20 or less	270 cy/acre (2" Layer)	540 cy/acre (4" Layer)
20 to 60	405 cy/acre (3" Layer)	675 cy/acre (5" Layer)
60 to 100	540 cy/acre (4" Layer)	810 cy/acre (6" Layer)*
* For slopes between 2H:1V and 1H:1V use this rate with a max. slope length of 40 ft.		

Construction Specifications

1. Compost shall be placed evenly and must provide 100% soil coverage (no soil visible). On highly unstable soils, use compost in conjunction with appropriate structural measures.
2. Spread the compost uniformly to the design thickness by hand or mechanically (e.g. with a manure spreader, front end loader, dozer, pneumatic blower, etc.) and then track (compact) the compost layer using a bulldozer or other appropriate equipment.
3. When using a pneumatic (blower) unit, shoot the compost directly at soil, to provide a tighter interface between the soil and compost and prevent water from moving between the two layers.
4. Apply compost layer approximately 3 feet beyond the top of the slope or overlap it into existing vegetation.
5. Follow by seeding or ornamental planting as specified.
6. When planting immediate grass, wildflower, or legume seeding or ornamental planting, use only a well composted product that contains no substances toxic to plants.

7. Very coarse composts should be avoided if the slope is to be landscaped or seeded, as it will make planting and crop establishment more difficult. Composts containing fibrous particles that range in size produce a more stable mat.

Hydraulically Applied Blankets

These blankets are formed by mixing different types of materials with water and are then applied using standard hydroseeding equipment. These blankets should not be used in areas of concentrated flow such as ditches and channels.

- A. **Bonded Fiber Matrix (BFM)** - This method makes use of a cross-linked hydrocolloid tackifier to bond thermally processed wood fibers. Application rates vary according to site conditions. For slopes up to 3H:1V the BFM should be applied at a rate of 3,000 lb/acre. Steeper slopes may need as much as 4,000 lb/acre in accordance with the manufacturer's recommendations.

BFMs should only be used when no rain is forecast for at least 48 hours following the application. This is to allow the tackifier sufficient time to cure properly. Once properly applied, a BFM is very effective in preventing accelerated erosion. **Bonded Fiber Matrix should not be applied between September 30 and April 1 to allow for proper curing of the polymer.**

- B. **Flexible Growth Medium (FGM)** - This method has the added component of 1/2 inch long, crimped manmade fibers which add a mechanical bond to the chemical bond provided by BFMs. This increases the blanket's resistance to both raindrop impact and erosion due to runoff. Unlike BFMs, a flexible growth medium typically does not require a curing time to be effective. Properly applied, an FGM is also very effective.

There is no need to smooth the slope prior to application. In fact some roughening of the surface (either natural or mechanically induced) is preferable. However, large rocks (≥ 9 inches) and existing rills should be removed prior to application. Mixing and application rates should follow manufacturer's recommendations.

- C. **Polymer Stabilized Fiber Matrix (PSFM)** - PSFMs make use of a linear soil stabilization tackifier that works directly on soil to maintain soil structure, maintain pore space capacity and flocculate dislodged sediment that will significantly reduce runoff turbidity. PSFMs can be used in re-vegetation applications and for site winterization and/or dormant seeding - fall planting for spring germination - applications. Application rates vary according to site conditions and

should be in accordance with manufacturers recommendations.

Construction Specifications

BFMs, FGMs and PSFMs are typically applied in two stages. Unless specifically recommended to be applied in one application by the manufacturer, the seed mixture and soil amendments should be applied first. If the seed is applied at the same time as the hydraulically applied blankets, the bonded fibers may keep the seed from making sufficient contact with the soil to germinate. After the seed mixture is applied, the hydraulically applied blankets should be sprayed over the area at the required application rate, according to the manufactures recommendations.



STANDARD AND SPECIFICATIONS FOR MULCHING



Definition and Scope

Applying coarse plant residue or chips, or other suitable materials, to cover the soil surface to provide initial erosion control while a seeding or shrub planting is establishing. Mulch will conserve moisture and modify the surface soil temperature and reduce fluctuation of both. Mulch will prevent soil surface crusting and aid in weed control. Mulch can also be used alone for temporary stabilization in non-growing months. Use of stone as a mulch could be more permanent and should not be limited to non-growing months.

Conditions Where Practice Applies

On soils subject to erosion and on new seedings and shrub plantings. Mulch is useful on soils with low infiltration rates by retarding runoff.

Criteria

Site preparation prior to mulching requires the installation of necessary erosion control or water management practices and drainage systems.

Slope, grade and smooth the site to fit needs of selected mulch products.

Remove all undesirable stones and other debris to meet the needs of the anticipated land use and maintenance required.

Apply mulch after soil amendments and planting is accomplished or simultaneously if hydroseeding is used.

Select appropriate mulch material and application rate or material needs. Hay mulch shall not be used in wetlands or in areas of permanent seeding. Clean straw mulch is preferred alternative in wetland application. Determine local availability.

Select appropriate mulch anchoring material.

NOTE: The best combination for grass/legume establishment is straw (cereal grain) mulch applied at 2 ton/acre (90 lbs./1000sq.ft.) and anchored with wood fiber mulch (hydromulch) at 500 – 750 lbs./acre (11 – 17 lbs./1000 sq. ft.). The wood fiber mulch must be applied through a hydroseeder immediately after mulching.



Table 4.2
Guide to Mulch Materials, Rates, and Uses

Mulch Material	Quality Standards	per 1000 Sq. Ft.	per Acre	Depth of Application	Remarks
Wood chips or shavings	Air-dried. Free of objectionable coarse material	500-900 lbs.	10-20 tons	2-7"	Used primarily around shrub and tree plantings and recreation trails to inhibit weed competition. Resistant to wind blowing. Decomposes slowly.
Wood fiber cellulose (partly digested wood fibers)	Made from natural wood usually with green dye and dispersing agent	50 lbs.	2,000 lbs.	—	Apply with hydromulcher. No tie down required. Less erosion control provided than 2 tons of hay or straw.
Gravel, Crushed Stone or Slag	Washed; Size 2B or 3A—1 1/2"	9 cu. yds.	405 cu. yds.	3"	Excellent mulch for short slopes and around plants and ornaments. Use 2B where subject to traffic. (Approximately 2,000 lbs./cu. yd.). Frequently used over filter fabric for better weed control.
Hay or Straw	Air-dried; free of undesirable seeds & coarse materials	90-100 lbs. 2-3 bales	2 tons (100-120 bales)	cover about 90% surface	Use small grain straw where mulch is maintained for more than three months. Subject to wind blowing unless anchored. Most commonly used mulching material. Provides the best micro-environment for germinating seeds.
Jute twisted yarn	Undyed, unbleached plain weave. Warp 78 ends/yd., Weft 41 ends/yd. 60-90 lbs./roll	48" x 50 yds. or 48" x 75 yds.	—	—	Use without additional mulch. Tie down as per manufacturers specifications. Good for center line of concentrated water flow.
Excelsior wood fiber mats	Interlocking web of excelsior fibers with photodegradable plastic netting	4' x 112.5' or 8' x 112.5'.	—	—	Use without additional mulch. Excellent for seeding establishment. Anchor as per manufacturers specifications. Approximately 72 lbs./roll for excelsior with plastic on both sides. Use two sided plastic for centerline of waterways.
Straw or coconut fiber, or combination	Photodegradable plastic net on one or two sides	Most are 6.5 ft. x 3.5 ft.	81 rolls	—	Designed to tolerate higher velocity water flow, centerlines of waterways, 60 sq. yds. per roll.

Table 4.3
Mulch Anchoring Guide

Anchoring Method or Material	Kind of Mulch to be Anchored	How to Apply
1. Peg and Twine	Hay or straw	After mulching, divide areas into blocks approximately 1 sq. yd. in size. Drive 4-6 pegs per block to within 2" to 3" of soil surface. Secure mulch to surface by stretching twine between pegs in criss-cross pattern on each block. Secure twine around each peg with 2 or more tight turns. Drive pegs flush with soil. Driving stakes into ground tightens the twine.
2. Mulch netting	Hay or straw	Staple the light-weight paper, jute, wood fiber, or plastic nettings to soil surface according to manufacturer's recommendations. Should be biodegradable. Most products are not suitable for foot traffic.
3. Wood cellulose fiber	Hay or straw	Apply with hydroseeder immediately after mulching. Use 500 lbs. wood fiber per acre. Some products contain an adhesive material ("tackifier"), possibly advantageous.
4. Mulch anchoring tool	Hay or straw	Apply mulch and pull a mulch anchoring tool (blunt, straight discs) over mulch as near to the contour as possible. Mulch material should be "tucked" into soil surface about 3".
5. Tackifier	Hay or straw	Mix and apply polymeric and gum tackifiers according to manufacturer's instructions. Avoid application during rain. A 24-hour curing period and a soil temperature higher than 45 ^o Fahrenheit are required.

STANDARD AND SPECIFICATIONS FOR PERMANENT CONSTRUCTION AREA PLANTING



Definition & Scope

Establishing **permanent** grasses with other forbs and/or shrubs to provide a minimum 80% perennial vegetative cover on areas disturbed by construction and critical areas to reduce erosion and sediment transport. Critical areas may include but are not limited to steep excavated cut or fill slopes as well as eroding or denuded natural slopes and areas subject to erosion.

Conditions Where Practice Applies

This practice applies to all disturbed areas void of, or having insufficient, cover to prevent erosion and sediment transport. See additional standards for special situations such as sand dunes and sand and gravel pits.

Criteria

All water control measures will be installed as needed prior to final grading and seedbed preparation. Any severely compacted sections will require chiseling or disking to provide an adequate rooting zone, to a minimum depth of 12", see Soil Restoration Standard. The seedbed must be prepared to allow good soil to seed contact, with the soil not too soft and not too compact. Adequate soil moisture must be present to accomplish this. If surface is powder dry or sticky wet, postpone operations until moisture changes to a favorable condition. If seeding is accomplished within 24 hours of final grading, additional scarification is generally not needed, especially on ditch or stream banks. Remove all stones and other debris from the surface that are greater than 4 inches, or that will interfere with future mowing or maintenance.

Soil amendments should be incorporated into the upper 2 inches of soil when feasible. **The soil should be tested to determine the amounts of amendments needed.** Apply

ground agricultural limestone to attain a pH of 6.0 in the upper 2 inches of soil. If soil must be fertilized before results of a soil test can be obtained to determine fertilizer needs, apply commercial fertilizer at 600 lbs. per acre of 5-5-10 or equivalent. If manure is used, apply a quantity to meet the nutrients of the above fertilizer. This requires an appropriate manure analysis prior to applying to the site. Do not use manure on sites to be planted with birdsfoot trefoil or in the path of concentrated water flow.

Seed mixtures may vary depending on location within the state and time of seeding. Generally, warm season grasses should only be seeded during early spring, April to May. These grasses are primarily used for vegetating excessively drained sands and gravels. See Standard and Specification for Sand and Gravel Mine Reclamation. Other grasses may be seeded any time of the year when the soil is not frozen and is workable. When legumes such as birdsfoot trefoil are included, spring seeding is preferred. See Table 4.4, "Permanent Construction Area Planting Mixture Recommendations" for additional seed mixtures.

<u>General Seed Mix:</u>	Variety	lbs./acre	lbs/1000 sq. ft.
Red Clover ¹ <u>OR</u>	Acclaim, Rally, Red Head II, Renegade	8 ²	0.20
Common white clover ¹	Common	8	0.20
<u>PLUS</u>			
Creeping Red Fescue	Common	20	0.45
<u>PLUS</u>			
Smooth Bromegrass <u>OR</u>	Common	2	0.05
Ryegrass (perennial)	Pennfine/Linn	5	0.10
¹ add inoculant immediately prior to seeding ² Mix 4 lbs each of Empire and Pardee OR 4 lbs of Birdsfoot and 4 lbs white clover per acre. All seeding rates are given for Pure Live Seed (PLS)			

Pure Live Seed, or (PLS) refers to the amount of live seed in a lot of bulk seed. Information on the seed bag label includes the type of seed, supplier, test date, source of seed, purity, and germination. Purity is the percentage of pure seed. Germination is the percentage of pure seed that will produce normal plants when planted under favorable conditions.

To compute Pure Live Seed multiply the “germination percent” times the “purity” and divide that by 100 to get Pure Live Seed.

$$\text{Pure Live Seed (PLS)} = \frac{\% \text{ Germination} \times \% \text{ Purity}}{100}$$

For example, the PLS for a lot of Kentucky Blue grass with 75% purity and 96% germination would be calculated as follows:

$$\frac{(96) \times (75)}{100} = 72\% \text{ Pure Live Seed}$$

For 10lbs of PLS from this lot =

$$\frac{10}{0.72} = 13.9 \text{ lbs}$$

Therefore, 13.9 lbs of seed is the actual weight needed to meet 10lbs PSL from this specific seed lot.

Time of Seeding: The optimum timing for the general seed mixture is early spring. Permanent seedings may be made any time of year if properly mulched and adequate moisture is provided. Late June through early August is not a good time to seed, but may facilitate covering the land without additional disturbance if construction is completed. Portions of the seeding may fail due to drought and heat. These areas may need reseeding in late summer/fall or the following spring.

Method of seeding: Broadcasting, drilling, cultipack type seeding, or hydroseeding are acceptable methods. Proper soil to seed contact is key to successful seedings.

Mulching: Mulching is essential to obtain a uniform stand of seeded plants. Optimum benefits of mulching new seedings are obtained with the use of small grain straw applied at a rate of 2 tons per acre, and anchored with a netting or tackifier. See the Standard and Specifications for Mulching for choices and requirements.

Irrigation: Watering may be essential to establish a new seeding when a drought condition occurs shortly after a new seeding emerges. Irrigation is a specialized practice and care must be taken not to exceed the application rate for the soil or subsoil. When disconnecting irrigation pipe, be sure pipes are drained in a safe manor, not creating an erosion concern.



80% Perennial Vegetative Cover



50% Perennial Vegetative Cover

**Table 4.4
Permanent Construction Area Planting Mixture Recommendations**

Seed Mixture	Variety	Rate in lbs./acre (PLS)	Rate in lbs./1,000 ft ²
Mix #1			
Creeping red fescue	Ensylva, Pennlawn, Boreal	10	.25
Perennial ryegrass	Pennfine, Linn	10	.25
*This mix is used extensively for shaded areas.			
Mix #2			
Switchgrass	Shelter, Pathfinder, Trailblazer, or Blackwell	20	.50
*This rate is in pure live seed, this would be an excellent choice along the upland edge of a wetland to filter runoff and provide wildlife benefits. In areas where erosion may be a problem, a companion seeding of sand lovegrass should be added to provide quick cover at a rate of 2 lbs. per acre (0.05 lbs. per 1000 sq. ft.).			
Mix #3			
Switchgrass	Shelter, Pathfinder, Trailblazer, or Blackwell	4	.10
Big bluestem	Niagara	4	.10
Little bluestem	Aldous or Camper	2	.05
Indiangrass	Rumsey	4	.10
Coastal panicgrass	Atlantic	2	.05
Sideoats grama	El Reno or Trailway	2	.05
Wildflower mix		.50	.01
*This mix has been successful on sand and gravel plantings. It is very difficult to seed without a warm season grass seeder such as a Truax seed drill. Broadcasting this seed is very difficult due to the fluffy nature of some of the seed, such as bluestems and indiangrass.			
Mix #4			
Switchgrass	Shelter, Pathfinder, Trailblazer, or Blackwell	10	.25
Coastal panicgrass	Atlantic	10	.25
*This mix is salt tolerant, a good choice along the upland edge of tidal areas and roadsides.			
Mix #5			
Saltmeadow cordgrass (<i>Spartina patens</i>)—This grass is used for tidal shoreline protection and tidal marsh restoration. It is planted by vegetative stem divisions.			
'Cape' American beachgrass can be planted for sand dune stabilization above the saltmeadow cordgrass zone.			
Mix #6			
Creeping red fescue	Ensylva, Pennlawn, Boreal	20	.45
Chewings Fescue	Common	20	.45
Perennial ryegrass	Pennfine, Linn	5	.10
Red Clover	Common	10	.45
*General purpose erosion control mix. Not to be used for a turf planting or play grounds.			

STANDARD AND SPECIFICATIONS FOR RECREATION AREA SEEDING



Definition & Scope

Establishing **permanent** grasses, legumes, vines, shrubs, trees, or other plants, or selectively reducing stand density and trimming woody plants, to improve an area for recreation. To increase the attractiveness and usefulness of recreation areas and to protect the soil and plant resources.

Conditions Where Practice Applies

On any area planned for recreation use, lawns, and areas that will be maintained in a closely mowed condition.

Specifications

ESTABLISHING GRASSES (Turfgrass)

The following applies for playgrounds, parks, athletic fields, camping areas, picnic areas, passive recreation areas such as lawns, and similar areas.

1. Time of Planting

Fall planting is preferred. Seed after August 15. In the spring, plant until May 15.

If seeding is done between May 15 and August 15, irrigation may be necessary to ensure a successful seeding.

2. Site Preparation

- A. Install needed water and erosion control measures and bring area to be seeded to desired grades. A minimum of 4 in. topsoil is required.
- B. Prepare seedbed by loosening soil to a depth of 4-6 inches and decompacting required areas per Soil Restoration Standard.
- C. See Standard and Specification of Topsoiling.

D. Lime to a pH of 6.5. See Lime Application Standard.

E. **Fertilize as per soil test** or, if soil must be fertilized before results of a soil test can be obtained to determine fertilizer needs, apply commercial fertilizer at 850 pounds of 5-5-10 or equivalent per acre (20 lbs/1,000 sq. ft.). See Fertilizer Application Standard.

F. Incorporate lime and fertilizer in top 2-4 inches of topsoil.

G. Smooth. Remove sticks, foreign matter, and stones over 1 inch in diameter, from the surface. Firm the seedbed.

3. Planting

Use a cultipacker type seeder if possible. Seed to a depth of 1/8 to 1/4 inch. If seed is to be broadcast, cultipack or roll after seeding. If hyroseeded, lime and fertilizer may be applied through the seeder, and rolling is not practical.

4. Mulching

Mulch all seedings in accordance with Standard and Specifications for Mulching. Small grain straw is the best material.

5. Seed Mixtures

Select seed mixture for site conditions and intended use from Table 4.5.

6. Contact Cornell Cooperative Extension Turf Specialist for suitable varieties.

Turf-type tall fescues have replaced the old KY31 tall fescues. New varieties have finer leaves and are the most resistant grass to foot traffic. Do not mix it with fine textured grasses such as bluegrass and red fescue.

Common ryegrass and redtop, which are relatively short lived species, provide quick green cover. Improved lawn cultivars of perennial ryegrass provide excellent quality turf, but continue to lack winter hardiness.

Common white clover can be added to mixtures at the rate of 1-2 lbs/acre to help maintain green color during the dry summer period; however, they will not withstand heavy traffic. Avoid using around swimming areas as flowers attract bees which can be easily stepped on.

**Table 4.5
Recreation Turfgrass Seed Mixture**

Site - Use	Species (% by weight)	lbs/1,000 ft ² (PLS)	lbs/acre (PLS)
Sunny Sites (well, moderately well, and somewhat poorly drained soils)	<i>Athletic fields and similar areas</i>		
	80% Hard fescue	2.4-3.2	105-138
	20% Perennial ryegrass	<u>0.6-0.8</u>	<u>25-37</u>
		3.0-4.0	130-175
	<u>OR</u> , for southern and eastern, NY 50% Hard fescue	1.5-2.0	65-88
	50% perennial ryegrass	<u>1.5-2.0</u>	<u>65-87</u>
		3.0-4.0	130-175
	<u>OR</u> , 100% Creeping Red Fescue	3.4-4.6	150-200
	<i>General recreation areas and lawns (Medium to high maintenance)</i>		
	65% Creeping red fescue	2.0-2.6	85-114
	20% Perennial ryegrass	0.6-0.8	26-35
	15% Fine fescue	<u>0.4-0.6</u>	<u>19-26</u>
		3.0-4.0	130-175
	<u>OR</u> , 100% Creeping red fescue	3.4-4.6	150-200
Sunny Droughty Sites (general recreation areas and lawns, low maintenance) (somewhat excessively to excessively drained soils, excluding Long Island)	65% Fine fescue	2.6-3.3	114-143
	15% Perennial ryegrass	0.6-0.7	26-33
	20% Creeping red fescue	<u>0.8-1.0</u>	<u>35-44</u>
		4.0-5.0	175-220
	<u>OR</u> , 100% Creeping red fescue	3.4-4.6	150-200
Shady Dry Sites (well to somewhat poorly drained soils)	65% fine fescue	2.6-3.3	114-143
	15% perennial ryegrass	0.6-0.7	26-33
	20% Creeping red fescue	<u>0.8-1.0</u>	<u>35-44</u>
	<u>OR</u>	4.0-5.0	174-220
	80% blend of shade-tolerant Ceral rye	2.4-3.2	105-138
	20% perennial ryegrass	<u>0.6-0.8</u>	<u>25-37</u>
	<u>OR</u>	3.0-4.0	130-175
	100% Creeping red fescue	3.4-4.6	150-200
Shady Wet Sites (somewhat poor to poorly drained soils)	70% Creeping red fescue	1.4-2.1	60-91
	30% blend of shade-tolerant Hard fescue	<u>0.6-0.9</u>	<u>25-39</u>
	<u>OR</u>	2.0-3.0	85-130
	100% Chewings fescue	3.4-4.6	150-200
For varieties suitable for specific locations, contact Cornell Cooperative Extension Turf Specialist. Reference: Thurn, M.C., N.W. Hummel, and A.M. Petrovic. Cornell Extension Pub. Info. Bulletin 185 Revised. HomeLawns Establishment and Maintenance. 1994.			

7. Fertilizing—First Year

Apply fertilizer as indicated by the soil test three to four weeks after germination (spring seedlings). If test results have not been obtained, apply 1 pound nitrogen/1,000 square feet using a complete fertilizer with a 2-1-1 or 4-1-3 ratio. Summer and early fall seedings, apply as above unless air temperatures are above 85°F for an extended period. Wait for cooler temperatures to fertilize. Late fall/winter seedings, fertilize in spring.

8. Restrict Use

New seedlings should be protected from use for one full year or a spring and fall growth cycle where possible to allow development of a dense sod with good root structure.

MAINTAINING GRASSES

1. Maintain a pH of 6.0 - 7.0.
2. Fertilize in late May to early June as follows with 5-5-10 analysis fertilizer at the rate of 5 lbs./1,000 sq. ft. and repeat in late August if sod density is not adequate. Avoid fertilizing when heat is greater than 85°F. Top dress weak sod annually in the spring, but at least once every 2 to 3 years. **Fertilize in accordance with soil test analysis**, after determining adequate topsoil depth exists.
3. Aerate compacted or heavily used areas, like athletic fields, annually as soon as soil moisture conditions permit. Aerate area six to eight times using a spoon or hollow tine type aerator. Do not use solid spike equipment.
4. Reseed bare and thin areas annually with original seed mix.

STANDARD AND SPECIFICATIONS FOR RETAINING WALLS



Definition & Scope

A **permanent** structural wall constructed and located to prevent soil movement by retaining soil in place and preventing slope failures and movement of material down steep slopes.

Conditions Where Practice Applies

A retaining wall may be used where site constraints will not allow slope shaping and seeding to stabilize an area. Slope areas that demonstrate seepage problems or experience erosive conditions at the toe can utilize retaining walls to help stabilize these areas. Retaining walls can be built from mortared block or stone, cast-in-place concrete, railroad ties, gabions, and more recently, precast concrete modular units and segmented walls that form a gravity retaining wall (see Figure 4.16 and 4.17). These precast units allow for ease and quickness of installation while their granular backfill provides drainage. Selection of materials and type of wall should be based on hazard potential, load conditions, soil parameters, groundwater conditions, site constraints, and aesthetics.

Design Criteria

The design of any retaining wall structure must address the aspects of foundation bearing capacity, sliding, overturning, drainage and loading systems. **These are complex systems that should be designed by a licensed professional engineer.**

Bearing Capacity – A minimum factor of safety of 1.5 should be maintained as the ratio of the ultimate bearing capacity to the designed unit loading. Spread footers and

other methods may be used to meet factor requirements.

Sliding – A minimum factor of 2.0 should be maintained against sliding. This factor can be reduced to 1.5 when passive pressures on the front of the wall are ignored.

Overturning – A minimum factor of safety of 1.5 should be used as the ratio of the resisting moment (that which tends to keep the wall in place) to the overturning moment.

Drainage – Unless adequate provisions are made to control both surface and groundwater behind the retaining wall, a substantial increase in active pressures tending to slide or overturn the wall will result. When backfill is sloped down to a retaining wall, surface drainage should be provided. Drainage systems with adequate outlets should be provided behind retaining walls that are placed in cohesive soils. Drains should be graded or protected by filters so soil material will not move through the drainfill.

Load systems – Several different loads or combination of loads need to be considered when designing a retaining wall. The minimum load is the level backfill that the wall is being constructed to retain. Its unit weight will vary depending on its composition.

Additional loads such as line loads, surcharge loads, or slope fills, will add to make the composite design load system for the wall.

Construction Specifications

Concrete Walls

1. Foundation will be prepared by excavating to the lines and grades shown on the drawings and removing all objectionable material.
2. Subgrade will be compacted and kept moist at least 2 hours prior to placement of concrete.
3. Steel reinforcing will be in accordance with the schedule on the drawings and kept free of rust, scale, or dirt.
4. Exposed edges will be chamfered $\frac{3}{4}$ inches.
5. Drainfill will meet the gradations shown on the drawings.

6. Weep holes will be provided as drain outlets as shown on the drawings.



7. Concrete will be poured and cured in accordance with American Concrete Institute (ACI) specifications.

Precast Units

1. Foundation will be prepared by excavating to the lines and grades shown on the drawings.
2. Subgrade will be compacted and trimmed to receive the leveling beam.
3. Precast units will be placed in accordance with the manufacturers recommendation.
4. Granular fill placed in the precast bins shall be placed in 3-foot lifts, leveled off and compacted with a plate vibrator.

Segmented Walls

1. Foundation will be prepared by excavating to the lines and grades shown on the drawings.
2. Sub-grade will be compacted and screeded to form the base for the first course of wall units.
3. Units will be placed in accordance with the manufacturers recommendations, with each succeeding lift anchored and pinned as specified.
4. Granular fill will be placed behind the segmented wall to provide drainage. It shall be compacted with a plate vibrator. A drainage outlet will be provided as specified on the construction drawings.

Gabions

1. Foundation will be prepared by excavating to the lines and grades shown on the drawings.
2. Subgrade will be compacted and leveled to receive first layer of gabions. The first row will be keyed into the existing grade at the toe, a minimum of 1.5 feet.
3. Gabions will be placed according to the manufacturers recommendations.
4. Gabions will be filled with stone or crushed rock from 4 to 8 inches in diameter.

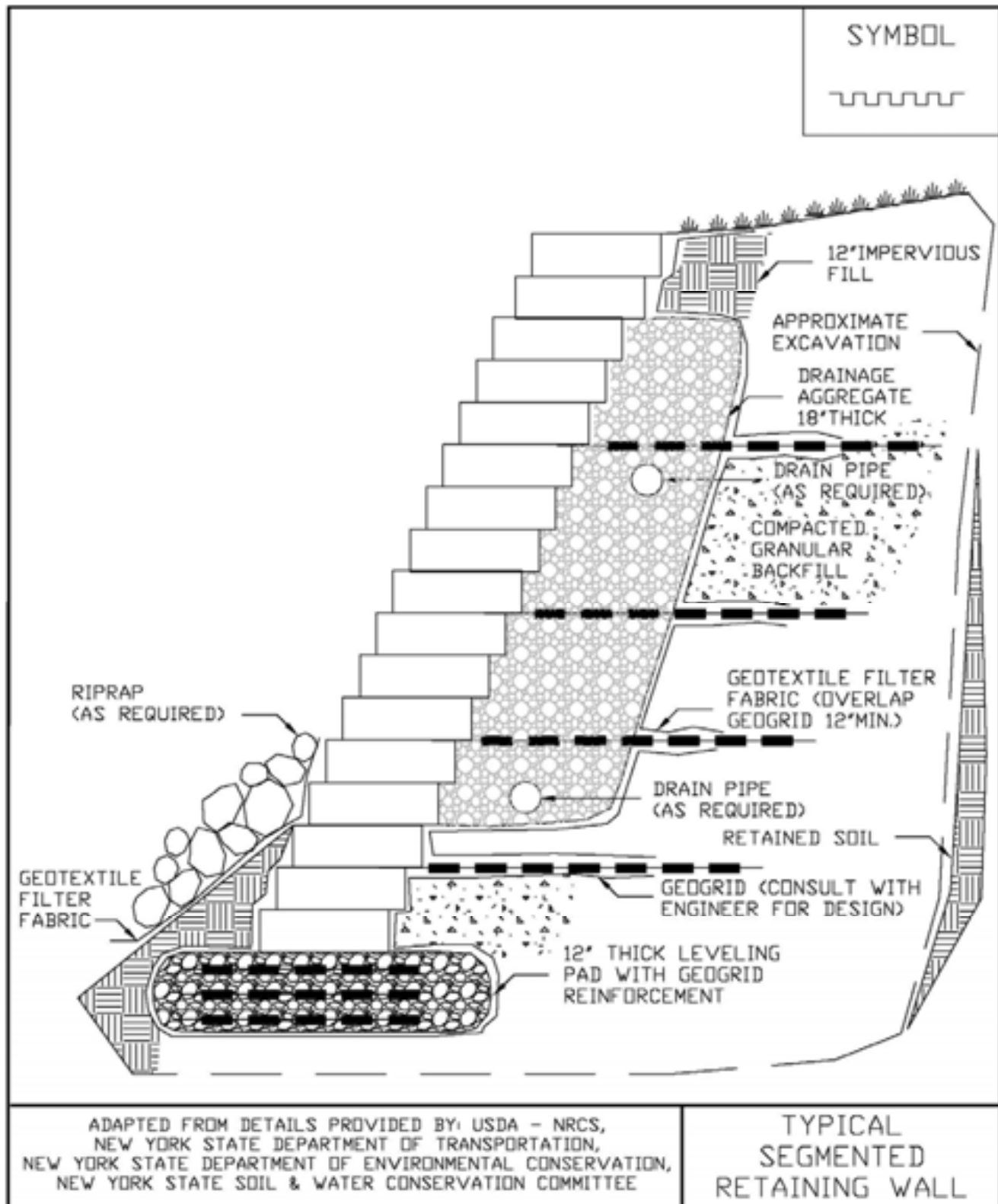


Non-Mortared Stone Walls

1. Foundation will be prepared by excavating to the lines and grade shown on the drawings.
2. Subgrade will be compacted and leveled to receive monolithic stone. First row will be placed 1.0 feet below design toe elevation.
3. Stone will be placed horizontally with long dimension parallel to face of wall except at return ends.
4. Maximum of 3 lifts of stone each approximately 2' thick without pinning. Where stones do not fit in good contact, pinning with two steel #8 re-bar dowels is required.
5. Backside of stone will be filled with a minimum of 2' of #1 and #2 stone between filter fabric against parent soil and rock to provide drainage.



Figure 4.17
Typical Segmented Retaining Wall Example
(Schematic only - not to be used for design)



STANDARD AND SPECIFICATIONS FOR SOIL RESTORATION



Definition & Scope

The decompaction of areas of a development site or construction project where soils have been disturbed to recover the original properties and porosity of the soil; thus providing a sustainable growth medium for vegetation, reduction of runoff and filtering of pollutants from stormwater runoff.

Conditions Where Practice Applies

Soil restoration is to be applied to areas whose heavy construction traffic is done and final stabilization is to begin. This is generally applied in the cleanup, site restoration, and landscaping phase of construction followed by the permanent establishment of an appropriate ground cover to maintain the soil structure. Soil restoration measures should be applied over and adjacent to any runoff reduction practices to achieve design performance.



Design Criteria

1. Soil restoration areas will be designated on the plan views of areas to be disturbed.

2. Soil restoration will be completed in accordance with Table 4.6 on page 4.53.

Specification for Full Soil Restoration

During periods of relatively low to moderate subsoil moisture, the disturbed subsoils are returned to rough grade and the following Soil Restoration steps applied:

1. Apply 3 inches of compost over subsoil. The compost shall be well decomposed (matured at least 3 months), weed-free, organic matter. It shall be aerobically composted, possess no objectionable odors, and contain less than 1%, by dry weight, of man-made foreign matter. The physical parameters of the compost shall meet the standards listed in Table 5.2 - Compost Standards Table, except for "Particle Size" 100% will pass the 1/2" sieve. **Note: All biosolids compost produced in New York State (or approved for importation) must meet NYS DEC's 6 NYCRR Part 360 (Solid Waste Management Facilities) requirements. The Part 360 requirements are equal to or more stringent than 40 CFR Part 503 which ensure safe standards for pathogen reduction and heavy metals content.**



2. Till compost into subsoil to a depth of at least 12 inches using a cat-mounted ripper, tractor mounted disc, or tiller, to mix and circulate air and compost into the subsoil.
3. Rock-pick until uplifted stone/rock materials of four inches and larger size are cleaned off the site.
4. Apply topsoil to a depth of 6 inches.
5. Vegetate as required by the seeding plan. Use appropriate ground cover with deep roots to maintain the soil structure.
6. Topsoil may be manufactured as a mixture or a mineral component and organic material such as compost.

At the end of the project an inspector should be able to push a 3/8” metal bar 12 inches into the soil just with body weight. This should not be performed within the drip line of any existing trees or over utility installations that are within 24 inches of the surface.

Maintenance

Keep the site free of vehicular and foot traffic or other weight loads. Consider pedestrian footpaths.

**Table 4.6
Soil Restoration Requirements**

Type of Soil Disturbance	Soil Restoration Requirement		Comments/Examples
No soil disturbance	Restoration not permitted		Preservation of Natural Features
Minimal soil disturbance	Restoration not required		Clearing and grubbing
Areas where topsoil is stripped only - no change in grade	HSG A&B	HSG C&D	Protect area from any ongoing construction activities.
	Apply 6 inches of topsoil	Aerate* and apply 6 inches of topsoil	
Areas of cut or fill	HSG A&B	HSG C&D	
	Aerate* and apply 6 inches of topsoil	Apply full Soil Restoration**	
Heavy traffic areas on site (especially in a zone 5-25 feet around buildings but not within a 5 foot perimeter around foundation walls)	Apply full Soil Restoration (decompaction and compost enhancement)		
Areas where Runoff Reduction and/or Infiltration practices are applied	Restoration not required, but may be applied to enhance the reduction specified for appropriate practices.		Keep construction equipment from crossing these areas. To protect newly installed practice from any ongoing construction activities construct a single phase operation fence area
Redevelopment projects	Soil Restoration is required on redevelopment projects in areas where existing impervious area will be converted to pervious area.		
<p>* Aeration includes the use of machines such as tractor-drawn implements with coulters making a narrow slit in the soil, a roller with many spikes making indentations in the soil, or prongs which function like a mini-subsoiler. ** Per “Deep Ripping and De-compaction, DEC 2008”.</p>			

STANDARD AND SPECIFICATIONS FOR STABILIZATION WITH SOD



Definition & Scope

Stabilizing restored, exposed soil surfaces by establishing long term stands of grass with sod to reduce damage from sediment and runoff to downstream areas and enhance natural beauty.

Conditions Where Practice Applies

On exposed soils that have a potential for causing off site environmental damage where a quick vegetative cover is desired. Moisture, either applied or natural, is essential to success.

Design Criteria

1. Sod shall be bluegrass or a bluegrass/red fescue mixture or a perennial ryegrass for average sites. (CAUTION: Perennial ryegrass has limited cold tolerance and may winter kill.) Use turf type cultivars of tall fescue for shady, droughty, or otherwise more critical areas. For variety selection, contact Cornell Cooperative Extension Turf Specialist.
2. Sod shall be machine cut at a uniform soil thickness of 3/4 inch, plus or minus 1/4 inch. Measurement for thickness shall exclude top growth and thatch.
3. Standard size sections of sod shall be strong enough to support their own weight and retain their size and shape when suspended vertically from a firm grasp on the upper 10 percent of the section.
4. Sod shall be free of weeds and undesirable coarse weedy grasses. Wild native or pasture grass sod shall not be used unless specified.
5. Sod shall not be harvested or transplanted when

moisture content (excessively dry or wet) may adversely affect its survival.

6. Sod shall be harvested, delivered, and installed within a period of 36 hours. Sod not transplanted within this period shall be inspected and approved by the contracting officer or his designated representative prior to its installation.

Site Preparation

Fertilizer and lime application rates shall be determined by soil tests. Under unusual circumstances where there is insufficient time for a complete soil test and the contracting officer agrees, fertilizer and lime materials may be applied in amounts shown in subsection 2 below. Slope land such as to provide good surface water drainage. Avoid depressions or pockets.

1. Prior to sodding, the surface shall be smoothed and cleared of all trash, debris, and of all roots, brush, wire, grade stakes and other objects that would interfere with planting, fertilizing or maintenance operations.
2. **The soil should be tested to determine the amounts of amendments needed.** Where the soil is acid or composed of heavy clays, ground limestone shall be spread to raise the pH to 6.5. If the soil must be fertilized before results of a soil test can be obtained to determine fertilizer needs, apply commercial fertilizer at 20 lbs. of 5-5-10 (or equivalent) and mix into the top 3 inches of soil with the required lime for every 1,000 square feet. Soil should be moist prior to sodding. Arrange for temporary storage of sod to keep it shaded and cool.

Sod Installation

1. For the operation of laying, tamping, and irrigating for any areas, sod shall be completed within eight hours. During periods of excessively high temperature, the soil shall be lightly moistened immediately prior to laying the sod.
2. The first row of sod shall be laid in a straight line with subsequent rows placed parallel to, and tightly wedged against, each other. Lateral joints shall be staggered to promote more uniform growth and strength. Ensure that sod is not stretched or overlapped and that all joints are butted tight in order to prevent voids which would cause air drying of the roots. On sloping areas where erosion may be a problem, sod shall be laid with the long edges parallel to the contour and with

staggered joints.

3. Secure the sod by tamping and pegging, or other approved methods. As sodding is completed in any one section, the entire area shall be rolled or tamped to ensure solid contact of roots with the soil surface.
4. Sod shall be watered immediately after rolling or tamping until the underside of the new sod pad and soil surface below the sod are thoroughly wet. Keep sod moist for at least two weeks.

Sod Maintenance

1. In the absence of adequate rainfall, watering shall be performed daily, or as often as deemed necessary by the inspector, during the first week and in sufficient quantities to maintain moist soil to a depth of 4 inches. Watering should be done in the morning. Avoid excessive watering during applications.
2. After the first week, sod shall be watered as necessary to maintain adequate moisture and ensure establishment.
3. The first mowing should not be attempted until sod is firmly rooted. No more than 1/3 of the grass leaf shall be removed by the initial cutting or subsequent cuttings. Grass height shall be maintained between 2 and 3 inches unless otherwise specified. Avoid heavy mowing equipment for several weeks to prevent rutting.
4. If the soil must be fertilized before results of a soil test can be obtained to determine fertilizer needs, apply fertilizer three to four weeks after sodding, at a rate of 1 pound nitrogen/1,000 sq.ft. Use a complete fertilizer with a 2-1-1 ratio.
5. Weed Control: Target herbicides for weeds present. Consult current Cornell Pest Control Recommendations for Commercial Turfgrass Management or consult the local office of Cornell Cooperative Extension.
6. Disease Control: Consult the local office of the Cornell Cooperative Extension.

Additional References

1. Home Lawns, Establishment and Maintenance, CCE Information Bulletin 185, Revised November 1994. Cornell University, Ithaca, NY.
2. Installing a Sod Lawn. CCE Suffolk County, NY. Thomas Kowalsick February 1994, Revised January 1999. www.cce.cornell.edu/counties/suffolk/grownet

STANDARD AND SPECIFICATIONS FOR SURFACE ROUGHENING



Definition & Scope

Roughening a bare soil surface whether through creating horizontal grooves across a slope, stair-stepping, or tracking with construction equipment to aid the establishment of vegetative cover from seed, to reduce runoff velocity and increase infiltration, and to reduce erosion and provide for trapping of sediment.

Conditions Where Practice Applies

All construction slopes require surface roughening to facilitate stabilization with vegetation, particularly slopes steeper than 3:1.

Design Criteria

There are many different methods to achieve a roughened soil surface on a slope. No specific design criteria is required. However, the selection of the appropriate method depends on the type of slope. Methods include tracking, grooving, and stair-stepping. Steepness, mowing requirements, and/or a cut or fill slope operation are all factors considered in choosing a roughening method.

Construction Specifications

1. Cut Slope, No mowing.
 - A. Stair-step grade or groove cut slopes with a gradient steeper than 3:1 (Figure 4.18).
 - B. Use stair-step grading on any erodible material soft enough to be ripped with a bulldozer. Slopes of soft rock with some soil are particularly suited to stair-step grading.

- C. Make the vertical cut distance less than the horizontal distance, and slightly slope the horizontal position of the “step” to the vertical wall.
- D. Do not make vertical cuts more than 2 feet in soft materials or 3 feet in rocky materials.

Grooving uses machinery to create a series of ridges and depressions that run perpendicular to the slope following the contour. Groove using any appropriate implement that can be safely operated on the slope, such as disks, tillers, spring harrows, or the teeth of a front-end loader bucket. Do not make the grooves less than 3 inches deep or more than 15 inches apart.

2. Fill Slope, No mowing

- A. Place fill to create slopes with a gradient no steeper than 2:1 in lifts 9 inches or less and properly compacted. Ensure the face of the slope consists of loose, uncompacted fill 4 to 6 inches deep. Use grooving as described above to roughen the slope, if necessary.
- B. Do not back blade or scrape the final slope face.

3. Cuts/Fills, Mowed Maintenance

- A. Make mowed slopes no steeper than 3:1.
- B. Roughen these areas to shallow grooves by normal tilling, disking, harrowing, or use of cultipacker-seeder. Make the final pass of such tillage equipment on the contour.
- C. Make grooves at least 1 inch deep and a maximum of 10 inches apart.
- D. Excessive roughness is undesirable where mowing is planned.

Tracking should be used primarily in sandy soils to avoid undue compaction of the soil surface. Tracking is generally not as effective as the other roughening methods described. (It has been used as a method to track down mulch.) Operate tracked machinery up and down the slope to leave horizontal depressions in the soil. Do not back-blade during the final grading operation.

Figure 4.18
Surface Roughening

